

AD-A036 780

WVT-TR-76050

FINITE ELEMENT STRESS ANALYSIS OF BOLT  
FOR MEDIUM CALIBER, ANTI-ARMOR AUTOMATIC CANNON,  
TEST BED NO. 2

TECHNICAL  
LIBRARY

James Harris  
John Higgins  
Frankford Arsenal  
Philadelphia, PA 19137

Prepared For



BENET WEAPONS LABORATORY  
WATERVLIET ARSENAL  
WATERVLIET, N.Y. 12189

December 1976

TECHNICAL REPORT

AMCMS No. 662603.11.H7800

DA Project No. 1W662603AH78

Pron No. M7-6-R0115-07-M7-M7

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

#### **DISPOSITION**

Destroy this report when it is no longer needed. Do not return it to the originator.

#### **DISCLAIMER**

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

## TABLE OF CONTENTS

	Page
REPORT DOCUMENTATION PAGE, DD FORM 1473	
INTRODUCTION	1
BOLT MODEL	2
RESULTS	3
DISCUSSION	4
CONCLUSIONS	4
APPENDIX A: STRESS ANALYSIS COMPUTER OUTPUT	5

### FIGURES

1 GEOMETRY PLOT	RUN 1	12
2 DISTORTION PLOT	RUN 1	13
3 STRESS PLOT	RUN 1	14
4 GEOMETRY PLOT	RUN 2	20
5 DISTORTION PLOT	RUN 2	21
6 STRESS PLOT	RUN 2	22
7 GEOMETRY PLOT	RUN 3	29
8 DISTORTION PLOT	RUN 3	30
9 STRESS PLOT	RUN 3	31
10 GEOMETRY PLOT	RUN 4	38
11 DISTORTION PLOT	RUN 4	39
12 STRESS PLOT	RUN 4	40
13 GEOMETRY PLOT	RUN 5	46
14 DISTORTION PLOT	RUN 5	47
15 STRESS PLOT	RUN 5	48
16 BOLT FACE DEFLECTION		49
17 BOLT-NASTRAN ANALYSIS DRAWING		50
18 BOLT-FINISH MACHINING DRAWING		51

## INTRODUCTION

This work has been performed for project 1W662603AH78, Armament Area 4: Armored Vehicle Armament Technology. The analysis presented is part of the on-going effort in the Medium Caliber Anti-Armor Automatic Cannon Program to produce several test bed automatic cannon for bench mark data generation purposes. Watervliet Arsenal is completing a 60mm unit which is a compact mechanism capable of rapid fire of high velocity KE rounds, incorporating advanced features to minimize barrel erosion and barrel vibration. This unit is designated Test Bed No. 2. Particulars of its structure and operation are available in references 1 and 2.

The bolt is a critical element in this weapon, being the item that closes the high pressure breech. The weapon will operate at chamber pressures between 70,000 and 100,000 psi. The operating pressures in the system are approximately twice those currently attained in present 60mm systems and are very close to the limits of present weapon technology. Because of the extreme operating conditions, a finite element program was used to model the weapon bolt assembly in the locked position at peak chamber pressure. Primarily the analysis is concerned with calculating and locating the maximum stress in the bolt cross section. The analysis was performed at Frankford Arsenal.

- 
1. Dynamic Analysis of Constant Reaction Systems for a Medium Caliber Anti-Armor Automatic Cannon, P. M. Vottis, J. K. Jorcak, Jul 76, Watervliet Arsenal, Watervliet, NY.
  2. (C) Dynamic Analysis of a Medium Caliber Anti-Armor Automatic Cannon (U), J. K. Jorcak, Jul 75, WVT-TR-75033, Watervliet Arsenal, Watervliet, New York

The bolt was modeled with a standard axisymmetric finite element program using constant strain elements. Modeling procedures for any axisymmetric problem are fairly simple and straightforward. The major steps in the analysis are:

1. Generate finite element mesh over the cross section.
2. Select boundary conditions appropriate to the problem.
3. Select material properties representative of material to be analyzed.

Since the actual bolt is not an axisymmetric body, some discussion of this approach is necessary.

#### Bolt Model

The bolt was modeled as an axisymmetric elastic body locked into a rigid bolt receiver. A pressure loading of 117,840 psi was applied to the bolt face, over the left edge of element numbers three to 12. The nodes on the right side of elements 36, 37, 38, 100, 101, 102, 152, 153, 154, etc., were restrained in the axial (Z) direction to simulate support given the bolt through the locking lugs by the barrel extension.

However, the actual bolt is not an axisymmetric body. Several holes are contained in the cross section modeled, thus weakening the bolt. Because of the lack of symmetry in the bolt geometry, the problem is three-dimensional and should be solved accordingly. Lack of time and money, however, necessitated a simpler approach.

The locking lugs which support the bolt during firing consist of ten sets of four segments, with each segment being slightly less than 45°. To model the bolt axisymmetrically, the locking lugs were considered solid disks. This required that the number of sets of lugs

be reduced to five so that the shear area at the root of the lugs remained approximately equal to the shear area of the actual lugs.

Next, the rearward force of the cartridge case on the bolt was calculated. Since the force is assumed to be applied uniformly, a pressure of 117,800 psi was calculated from the area of the case applying the force to the bolt face.

The best and worst cases were first analyzed. The best case is the bolt without any holes, and the worst (Run 2) is the bolt with a circular slot which is 0.93 inches wide and 0.95 inches deep in the rear face of the bolt. Figure 1 is the geometry plot for the best case, and Figure 4 is the geometry plot for Run 2.

Run 3 (Figure 7) is a variation of the Run 2, in which the circular slot was filled with a very low modulus (10 psi) material. Runs 4 and 5 are intermediate cases where the slot has the same volume as the original hole. In Run 4, Figure 10, the slot has the same width as the hole diameter (0.93 inches) but the depth is only 0.1162 inches. In Run 5, Figure 13, the slot has the same depth (0.95 inches) but is only 0.1138 inches wide and centered on the centerline of the original hole.

### Results

Computer printouts of the five models are included in Appendix A. The distorted cross section and stress field plots are in Figures 2 and 3, 5 and 6, 8 and 9, 11 and 12, 14 and 15 for Runs 1 to 5, respectively. The element with the highest stress is shaded in the geometry plot of each of the models.

A comparison of the deflection of the bolt face (nodal points 1 through 13) for the five models is given in Figure 16. Figure 17

is the bolt drawing prepared for the analysis and Figure 18 is a finish machine drawing of the bolt.

### Discussion

In Runs 1 and 4 the element with the highest stress is number 38, which is the element at the rear face of the root of the first locking lug. More important, however, is that the stress levels in that element in all runs are between 138,000 and 142,000 psi. The stress levels in this element will be lower than reported since the model assumes rigid support to the locking lugs while the barrel extension actually will elastically deform.

The element of maximum stress in Runs 2 and 3 is number 72, at 176,800 psi. These are the highest stressed elements of all the models because these models represent the weakest configuration (have the largest slot, thus minimum bolt material). Run 5 has the next highest stressed element, number 63, at 143,500 psi. This run is the most accurate of the five models and best represents the stiffness of the bolt.

### Conclusions

The yield strength value chosen for the model, 200,000 psi, is more than sufficient to withstand the forces of a 100,000 psi chamber pressure firing. If the worst case analysis of the bolt is considered, the lowest yield strength acceptable is approximately 180,000 psi. This would provide only a two per cent safety factor in the design of the bolt. However, since the most accurate model, Run 5, predicts a maximum stress of 143,500 psi, the safety factor would be 25 per cent.

## APPENDIX A

### STRESS ANALYSIS COMPUTER OUTPUT

## RUN 1

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****		STRESSES (KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES	
1	2.52	.69	3.30	3.44	-4.13	6.33	13.29	
2	2.31	.70	4.36	-29.13	-14.54	-7.70	31.99	
3	2.10	.70	-11.09	-90.84	-40.79	-17.00	75.76	
4	1.89	.70	-31.19	-119.37	-60.27	-8.66	79.26	
5	1.67	.70	-45.38	-117.01	-67.65	-7.47	64.80	
6	1.46	.70	-45.09	-90.19	-63.84	10.49	43.24	
7	1.25	.70	-30.00	-30.05	-44.77	13.15	27.13	
8	1.04	.70	-31.91	-25.20	-44.89	-18.50	36.43	
9	.83	.70	-59.69	-85.69	-75.54	-23.08	45.98	
10	.62	.70	-81.94	-117.47	-100.13	-6.37	32.68	
11	.41	.70	-89.34	-117.68	-112.78	-6.84	28.79	
12	.20	.70	-72.03	-103.35	-139.20	-17.08	65.30	
13	2.52	.87	-1.89	4.30	3.16	4.25	9.31	
14	2.30	.87	-1.13	-43.98	-11.20	-7.57	40.97	
15	2.09	.87	2.42	-93.55	-27.72	-24.43	94.96	
16	1.88	.87	-6.45	-113.84	-41.60	-27.23	105.91	
17	1.66	.87	-19.92	-104.44	-47.84	-14.01	78.44	
18	1.45	.87	-27.92	-75.54	-46.02	4.73	42.43	
19	1.24	.87	-42.83	-42.81	-42.62	2.50	4.34	
20	1.02	.87	-51.07	-45.39	-43.88	-22.40	39.35	
21	.81	.87	-48.82	-79.21	-52.14	-31.62	61.92	
22	.60	.88	-53.65	-106.39	-65.22	-21.29	60.54	
23	.38	.88	-55.15	-113.84	-78.00	-22.51	64.39	
24	.18	.84	-65.88	-132.74	-114.12	-36.25	86.69	
25	2.52	1.03	-1.18	4.86	9.61	2.28	10.17	
26	2.30	1.04	-.01	-57.78	-8.49	-2.02	54.14	
27	2.09	1.04	12.03	-105.24	-22.30	-26.35	113.97	
28	1.87	1.04	-3.29	-107.59	-33.10	-44.05	120.33	
29	1.65	1.04	-14.68	-84.37	-33.06	-21.41	72.72	
30	1.44	1.04	-21.63	-68.14	-33.14	-5.92	43.19	
31	1.22	1.04	-34.77	-53.56	-33.72	-9.55	25.45	
32	1.01	1.04	-40.70	-54.38	-34.15	-23.63	44.66	
33	.79	1.04	-40.14	-73.92	-38.21	-30.17	62.78	
34	.57	1.04	-39.90	-95.16	-45.57	-25.63	68.87	
35	.36	1.04	-32.82	-125.11	-59.62	-22.83	91.24	
36	2.52	1.21	-1.16	5.69	13.29	.82	12.60	
37	2.30	1.21	-2.71	-58.93	-5.81	1.25	54.78	
38	2.11	1.21	3.11	-149.98	-33.11	-15.44	141.14	
39	1.89	1.21	-12.58	-97.80	-27.44	-60.58	131.25	
40	1.65	1.21	-2.81	-61.42	-14.73	-22.24	66.05	
41	1.44	1.22	-12.13	-65.13	-21.01	-16.54	56.90	
42	1.22	1.22	-21.37	-57.08	-22.33	-17.80	46.83	
43	1.01	1.22	-27.67	-57.71	-23.77	-24.71	53.53	
44	.79	1.22	-28.68	-67.93	-25.86	-28.71	64.29	
45	.57	1.22	-27.07	-84.04	-30.05	-25.66	71.14	
46	.36	1.22	-14.28	-99.05	-37.83	-14.24	79.70	
47	2.11	1.44	16.86	92.12	43.44	.93	66.13	
48	1.93	1.39	15.53	16.58	23.17	-60.67	105.33	
49	1.70	1.40	4.03	-68.56	-8.41	-33.55	88.87	
50	1.50	1.40	.45	-59.00	-8.09	-25.84	71.43	

## CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****		STRESSES (KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES	
51	1.29	1.40	-7.74	-57.47	-11.29	-24.78	64.44	
52	1.08	1.40	-13.35	-55.60	-12.68	-26.38	62.46	
53	.87	1.40	-15.82	-58.89	-14.04	-27.67	65.05	
54	.66	1.40	-14.88	-66.14	-15.74	-25.27	67.09	
55	.50	1.45	-13.47	-74.59	-17.51	-22.08	70.49	
56	.35	1.40	-7.55	-77.11	-20.89	-11.42	66.93	
57	2.24	1.58	-9.16	4.35	9.61	.52	16.80	
58	2.03	1.58	-1.48	24.36	21.25	-30.23	57.78	
59	1.82	1.58	12.59	-22.73	12.82	-46.20	87.51	
60	1.61	1.58	8.45	-51.83	1.79	-36.77	85.63	
61	1.40	1.58	4.20	-52.71	-.83	-31.86	77.61	
62	1.19	1.58	-1.14	-52.06	-3.04	-30.47	72.69	
63	.98	1.58	-4.57	-51.10	-3.93	-29.71	69.60	
64	.77	1.58	-5.60	-52.79	-4.41	-27.38	67.34	
65	.56	1.58	-4.37	-56.50	-4.95	-21.39	63.72	
66	.35	1.59	-2.60	-59.51	-6.65	-9.57	57.44	
67	2.47	1.81	.06	-29	11.90	1.50	12.30	
68	2.32	1.76	-.10	-.43	12.56	-1.19	12.99	
69	2.10	1.77	-7.03	-1.37	12.17	-12.96	28.21	
70	1.88	1.77	2.75	-14.60	13.74	-36.24	67.47	
71	1.66	1.77	10.93	-36.72	10.22	-40.12	84.06	
72	1.45	1.77	9.22	-46.45	6.13	-36.19	82.86	
73	1.23	1.77	6.40	-45.92	4.86	-34.31	78.68	
74	1.01	1.77	3.81	-43.70	4.63	-31.67	72.84	
75	.79	1.77	2.99	-42.23	5.37	-27.38	66.39	
76	.58	1.77	3.47	-42.24	6.65	-20.48	59.19	
77	.36	1.77	2.70	-41.85	9.04	-9.21	50.61	
78	2.52	1.95	-.09	.50	13.68	1.38	13.70	
79	2.30	1.95	-.82	-7.20	12.76	-1.84	17.95	
80	2.09	1.95	-.52	-14.52	12.33	-13.18	32.59	
81	1.87	1.95	2.45	-23.43	12.23	-28.65	59.00	
82	1.65	1.95	7.60	-34.40	11.55	-36.10	76.51	
83	1.44	1.95	10.71	-40.22	10.92	-37.22	82.22	
84	1.22	1.95	10.38	-38.72	11.23	-36.02	79.65	
85	1.01	1.95	9.76	-34.25	12.86	-32.16	72.00	
86	.79	1.95	10.39	-30.83	15.36	-26.06	62.97	
87	.57	1.95	11.36	-28.83	18.73	-18.43	54.63	
88	.36	1.95	7.44	-26.29	25.04	-8.20	47.36	
89	2.52	2.13	-.85	1.59	15.49	1.48	15.48	
90	2.30	2.13	-1.69	-13.19	12.66	.35	22.44	
91	2.09	2.13	1.82	-24.94	11.64	-11.36	38.24	
92	1.87	2.13	.41	-30.48	10.88	-25.68	58.01	
93	1.65	2.13	5.11	-34.21	12.74	-30.50	68.53	
94	1.44	2.13	10.82	-36.85	14.49	-35.04	78.38	
95	1.22	2.13	12.44	-31.40	17.32	-35.77	77.45	
96	1.01	2.13	14.03	-23.62	21.75	-30.29	67.24	
97	.79	2.13	17.43	-19.09	26.88	-22.52	57.36	
98	.57	2.13	19.89	-16.84	32.76	-14.93	51.54	
99	.36	2.13	12.98	-13.26	43.46	-6.51	50.45	
100	2.52	2.31	-1.25	2.65	16.69	.68	16.39	

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****		STRESSES (KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES	
101	2.30	2.31	-4.22	-14.20	12.81	1.14	23.74	
102	2.11	2.31	-4.13	-43.87	5.72	-5.22	46.36	
103	1.89	2.31	-6.17	-32.29	9.99	-23.59	55.08	
104	1.65	2.31	2.60	-34.67	14.80	-21.53	58.16	
105	1.44	2.31	8.95	-37.37	17.29	-31.52	74.71	
106	1.22	2.31	11.81	-23.70	24.25	-33.08	71.71	
107	1.01	2.31	18.50	-11.65	33.62	-23.86	57.46	
108	.79	2.31	26.75	-8.21	41.93	-15.44	51.95	
109	.57	2.31	30.02	-7.74	50.07	-9.19	53.28	
110	.36	2.32	19.77	-4.11	66.01	-3.80	62.10	
111	1.98	2.44	8.75	31.09	34.62	-16.90	38.04	
112	1.74	2.44	-3.53	-35.49	13.89	-18.37	53.80	
113	1.58	2.46	-2.65	-40.25	14.86	-15.49	55.66	
114	1.42	2.44	2.97	-40.96	18.04	-29.82	74.08	
115	1.21	2.44	8.70	-17.17	30.92	-27.31	63.05	
116	1.00	2.44	26.25	-.74	46.85	-13.71	47.67	
117	.78	2.44	36.12	-2.33	55.42	-8.44	52.97	
118	.57	2.44	38.84	-1.91	65.59	-4.14	59.31	
119	.36	2.45	24.98	-.95	87.37	-.23	78.63	
120	2.10	2.54	-4.16	19.68	25.22	-6.08	29.02	
121	1.89	2.54	-2.13	.02	24.04	-20.57	43.62	
122	1.67	2.54	-10.40	-41.24	12.82	-16.69	55.16	
123	1.48	2.54	-12.83	-51.92	12.82	-23.70	69.81	
124	1.27	2.54	-3.27	-7.75	35.24	-17.90	51.36	
125	1.03	2.54	35.07	-.35	56.82	-.4.34	50.54	
126	.82	2.54	45.29	-.86	66.08	-3.34	59.63	
127	.61	2.54	47.39	-1.65	75.94	-1.52	68.02	
128	.39	2.55	30.99	-.97	96.18	1.76	85.82	
129	2.26	2.69	-4.68	5.48	18.08	-2.74	20.31	
130	2.11	2.73	-6.26	9.02	20.56	-5.56	25.21	
131	1.95	2.69	-10.82	-.85	19.61	-16.63	39.39	
132	1.75	2.69	-11.06	-21.44	17.73	-22.43	52.39	
133	1.56	2.69	-19.67	-71.92	4.34	-25.89	81.06	
134	2.44	2.87	-2.55	-1.38	14.09	-2.06	16.48	
135	2.29	2.91	-2.80	2.27	16.27	-3.34	18.07	
136	2.15	2.87	-7.71	.77	16.47	-7.62	25.01	
137	1.96	2.87	-9.37	-5.01	17.50	-15.01	36.05	
138	1.77	2.87	-9.56	-22.49	15.89	-19.71	48.06	
139	1.57	2.87	-1.51	-43.35	15.25	-12.41	56.52	
140	2.53	3.05	-.85	-3.25	12.68	-1.69	15.16	
141	2.34	3.05	-3.27	-2.51	13.72	-4.47	18.34	
142	2.15	3.05	-4.77	-2.99	15.24	-8.64	24.32	
143	1.96	3.05	-5.74	-8.81	15.79	-12.92	32.24	
144	1.76	3.05	-3.42	-19.04	16.25	-13.70	38.74	
145	1.57	3.05	-.90	-29.33	16.63	-6.90	41.91	
146	2.53	3.23	-.26	-6.32	11.37	-1.89	15.92	
147	2.34	3.23	-.54	-4.91	13.01	-4.83	18.21	
148	2.15	3.23	-1.32	-6.01	14.09	-7.80	22.68	
149	1.96	3.23	-.89	-9.50	15.10	-10.64	28.42	
150	1.76	3.23	-.68	-15.20	15.65	-9.82	31.68	

## CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****		STRESSES(KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES	
151	1.57	3.23	.30	-20.03	16.91	-4.20	32.86	
152	2.53	3.41	.23	-8.71	10.41	-.88	16.64	
153	2.34	3.41	2.33	-7.53	12.48	-2.64	17.92	
154	2.15	3.41	7.57	-8.21	14.82	-6.40	23.21	
155	1.96	3.41	1.89	-10.04	13.64	-10.93	27.91	
156	1.76	3.41	1.55	-10.54	15.24	-7.64	25.97	
157	1.57	3.41	.70	-13.76	16.16	-3.10	26.41	
158	2.11	3.64	-3.20	6.17	12.59	-6.58	17.86	
159	1.96	3.59	2.78	1.27	15.01	-12.37	25.09	
160	1.77	3.59	1.64	-7.05	13.67	-7.23	21.95	
161	1.57	3.59	.82	-8.16	15.05	-2.80	20.85	
162	2.30	3.83	-3.74	-5.28	5.43	-4.96	13.21	
163	2.15	3.78	-4.74	-1.26	7.55	-3.05	12.18	
164	1.96	3.78	-2.07	.99	10.72	-7.03	16.79	
165	1.77	3.78	.76	-2.12	12.25	-6.03	16.81	
166	1.57	3.78	.56	-3.40	13.59	-2.36	15.93	
167	2.48	4.01	-1.11	-3.87	4.62	-2.77	8.91	
168	2.34	3.96	-2.02	-3.67	5.14	-3.09	9.71	
169	2.15	3.96	-1.93	-1.49	6.67	-2.79	9.68	
170	1.96	3.96	-1.62	.12	8.42	-3.60	11.19	
171	1.76	3.96	-.14	-.02	10.20	-3.45	11.89	
172	1.57	3.96	.36	.25	12.04	-1.52	12.03	
173	2.53	4.15	-.40	-4.55	3.79	-1.91	7.94	
174	2.34	4.15	-.29	-3.37	4.62	-2.82	8.52	
175	2.15	4.15	-.58	-1.18	5.81	-2.43	7.92	
176	1.95	4.15	-.39	.37	7.21	-2.02	8.05	
177	1.76	4.15	.26	1.02	8.67	-1.58	8.51	
178	1.57	4.15	.34	2.16	10.39	-.64	9.34	
179	2.53	4.33	.25	-6.82	2.53	-1.47	8.81	
180	2.34	4.33	.76	-3.24	4.04	-2.63	7.78	
181	2.15	4.33	.45	-.30	5.28	-2.12	6.40	
182	1.95	4.33	.85	1.12	6.50	-.87	5.72	
183	1.76	4.33	1.01	1.55	7.47	-.62	6.30	
184	1.57	4.33	.44	2.91	8.79	-.24	7.44	
185	2.53	4.51	.37	-8.33	1.64	-.59	9.46	
186	2.34	4.51	2.02	-3.91	3.63	-1.39	7.29	
187	2.15	4.51	4.39	1.27	6.04	-2.31	5.80	
188	1.96	4.51	2.25	1.73	5.95	-.35	4.03	
189	1.76	4.51	1.24	1.62	6.16	-.64	4.87	
190	1.57	4.51	.47	3.36	7.33	-.24	5.98	
191	2.11	4.74	-1.71	-2.73	1.64	-2.98	6.51	
192	1.96	4.69	.80	.12	3.76	-1.12	3.87	
193	1.76	4.69	.77	2.28	4.91	-.78	3.87	
194	1.57	4.69	.32	3.83	5.96	-.28	4.96	
195	2.30	4.93	-1.20	-2.10	.82	-1.78	4.03	
196	2.15	4.88	-.88	-1.20	1.49	-.80	2.90	
197	1.96	4.88	-.27	.67	2.54	-.21	2.50	
198	1.77	4.88	.15	2.50	3.65	-.17	3.10	
199	1.57	4.88	.17	4.21	4.76	-.09	4.34	
200	2.48	5.11	-.33	-1.30	.67	-.94	2.35	

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES (KPSI)					
	R	Z	RR	ZZ	TT	RZ	MISES	
201	2.34	5.06	-.51	-1.24	.80	-.89	2.36	
202	2.15	5.06	-.16	-.40	1.30	-.30	1.68	
203	1.96	5.06	-.03	.99	1.96	.25	1.78	
204	1.76	5.06	.11	2.49	2.77	.37	2.61	
205	1.57	5.06	.11	4.11	3.71	.20	3.83	
206	2.53	5.25	-.09	-1.45	.39	-.60	1.95	
207	2.34	5.25	.07	-.84	.66	-.70	1.78	
208	2.15	5.25	.07	.23	1.07	-.12	.95	
209	1.95	5.25	.14	1.34	1.58	.52	1.60	
210	1.76	5.25	.24	2.40	2.15	.68	2.36	
211	1.57	5.25	.14	3.65	2.82	.36	3.24	
212	2.53	5.43	.11	-2.10	-.04	-.44	2.28	
213	2.34	5.43	.32	-.52	.50	-.66	1.48	
214	2.15	5.43	.15	.94	.94	-.10	.80	
215	1.95	5.43	.33	1.73	1.36	.85	1.94	
216	1.76	5.43	.46	2.16	1.66	.81	2.06	
217	1.57	5.43	.15	3.03	2.05	.34	2.60	
218	2.53	5.61	.14	-2.53	-.33	-.17	2.48	
219	2.34	5.61	.65	-.59	.37	-.37	1.29	
220	2.15	5.61	1.18	2.02	1.28	-.40	1.05	
221	1.96	5.61	.83	2.08	1.29	1.23	2.40	
222	1.76	5.61	.36	1.58	1.03	.56	1.44	
223	1.57	5.61	.12	2.55	1.40	.23	2.14	
224	2.11	5.84	-.60	-2.55	-.93	-.78	2.25	
225	1.96	5.79	-.07	-.48	-.15	.99	1.76	
226	1.76	5.79	.10	1.51	.56	.47	1.48	
227	1.57	5.79	.03	2.15	.81	.19	1.88	
228	2.30	6.03	-.25	-.49	-.41	-.38	.69	
229	2.15	5.98	.05	-.64	-.35	-.14	.64	
230	1.96	5.98	-.01	-.15	-.29	.76	1.34	
231	1.77	5.98	-.13	.99	.02	.67	1.57	
232	1.57	5.98	-.02	1.76	.32	.26	1.69	
233	2.48	6.21	-.08	-.27	-.42	-.23	.50	
234	2.34	6.16	-.11	-.27	-.44	-.20	.45	
235	2.15	6.16	.02	-.15	-.41	.08	.39	
236	1.96	6.16	.04	.20	-.35	.55	1.07	
237	1.76	6.16	-.04	.74	-.25	.65	1.45	
238	1.57	6.16	-.03	1.23	-.12	.33	1.42	
239	2.53	6.35	-.02	-.36	-.53	-.19	.55	
240	2.34	6.35	.01	-.11	-.50	-.21	.59	
241	2.15	6.35	-.01	.21	-.46	.09	.62	
242	1.95	6.35	.00	.44	-.44	.49	1.15	
243	1.76	6.35	.01	.59	-.46	.60	1.38	
244	1.57	6.35	.00	.70	-.50	.31	1.17	
245	2.53	6.53	.05	-.59	-.69	-.17	.76	
246	2.34	6.53	.15	.03	-.55	-.28	.80	
247	2.15	6.53	.04	.60	-.47	-.02	.93	
248	1.95	6.53	.06	.68	-.50	.54	1.38	
249	1.76	6.53	.15	.42	-.64	.51	1.31	
250	1.57	6.53	.02	.25	-.86	.19	1.07	

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****		STRESSES (KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES	
251	2.53	6.71	.08	-.77	-.80	-.08	.88	
252	2.34	6.71	.37	-.03	-.58	-.18	.88	
253	2.15	6.71	.73	1.12	-.25	-.28	1.31	
254	1.95	6.71	.58	.95	-.43	.63	1.65	
255	1.76	6.71	.07	.02	-1.02	.18	1.11	
256	1.57	6.71	-.04	.04	-.1.21	.03	1.22	

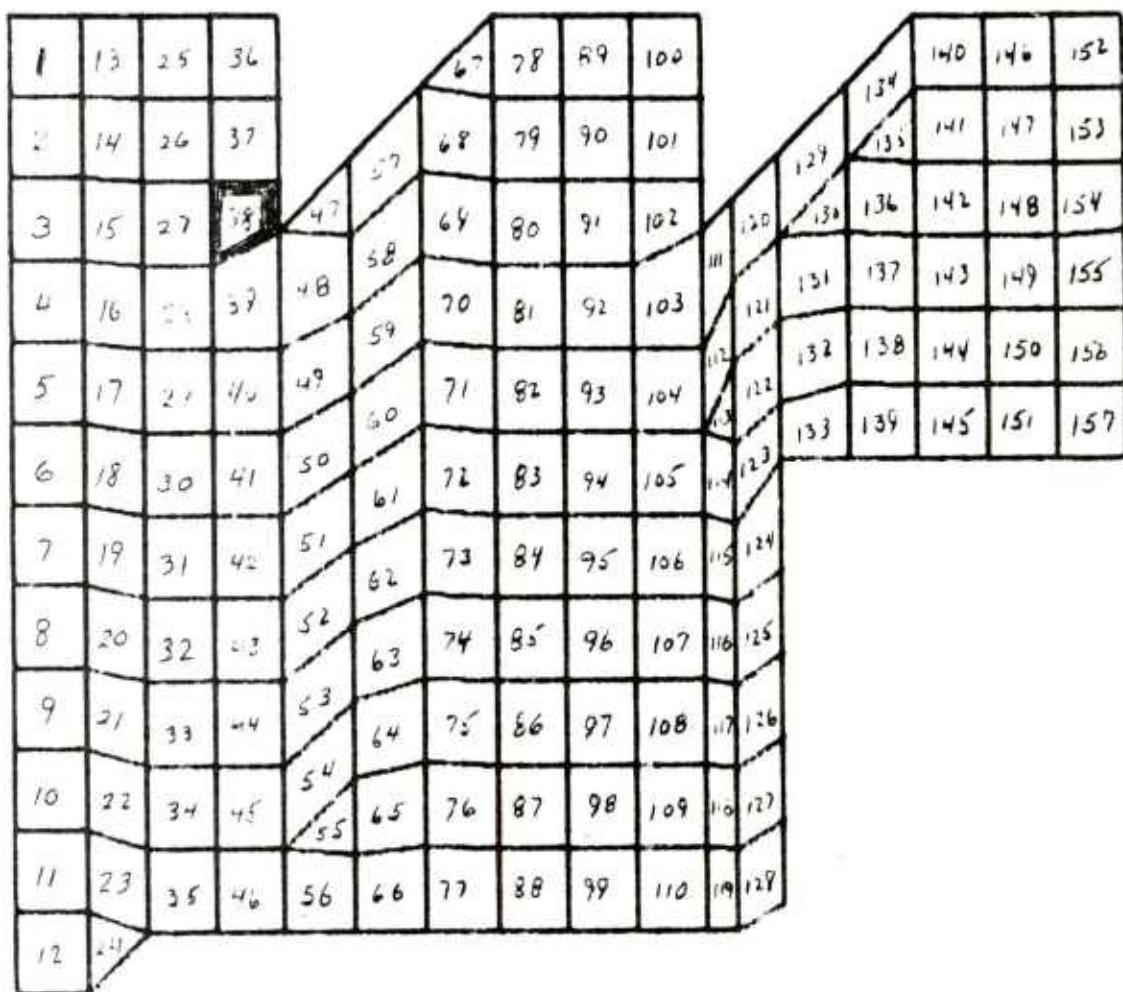


Figure 1. Geometry plot - Run 1.

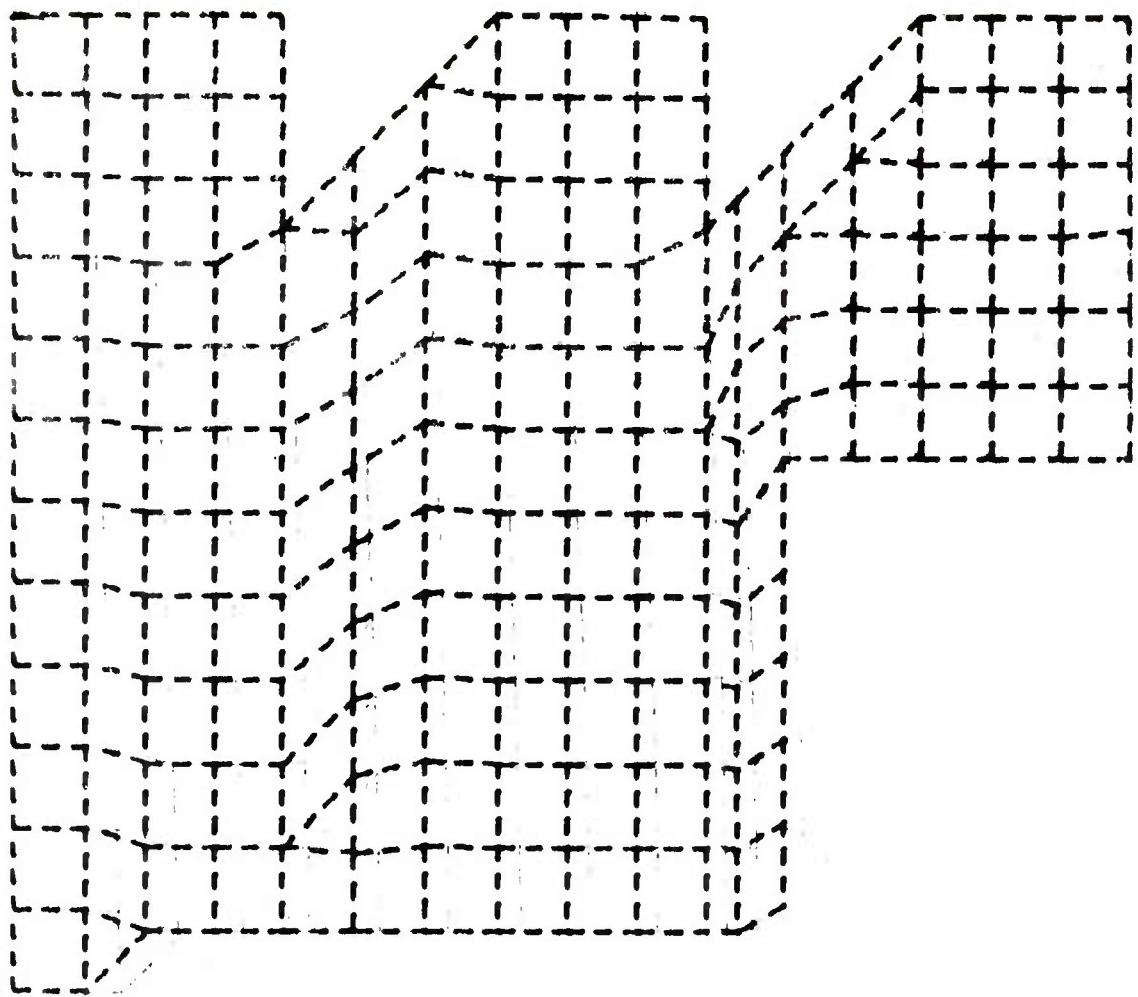


Figure 2. Distortion plot - Run 1.

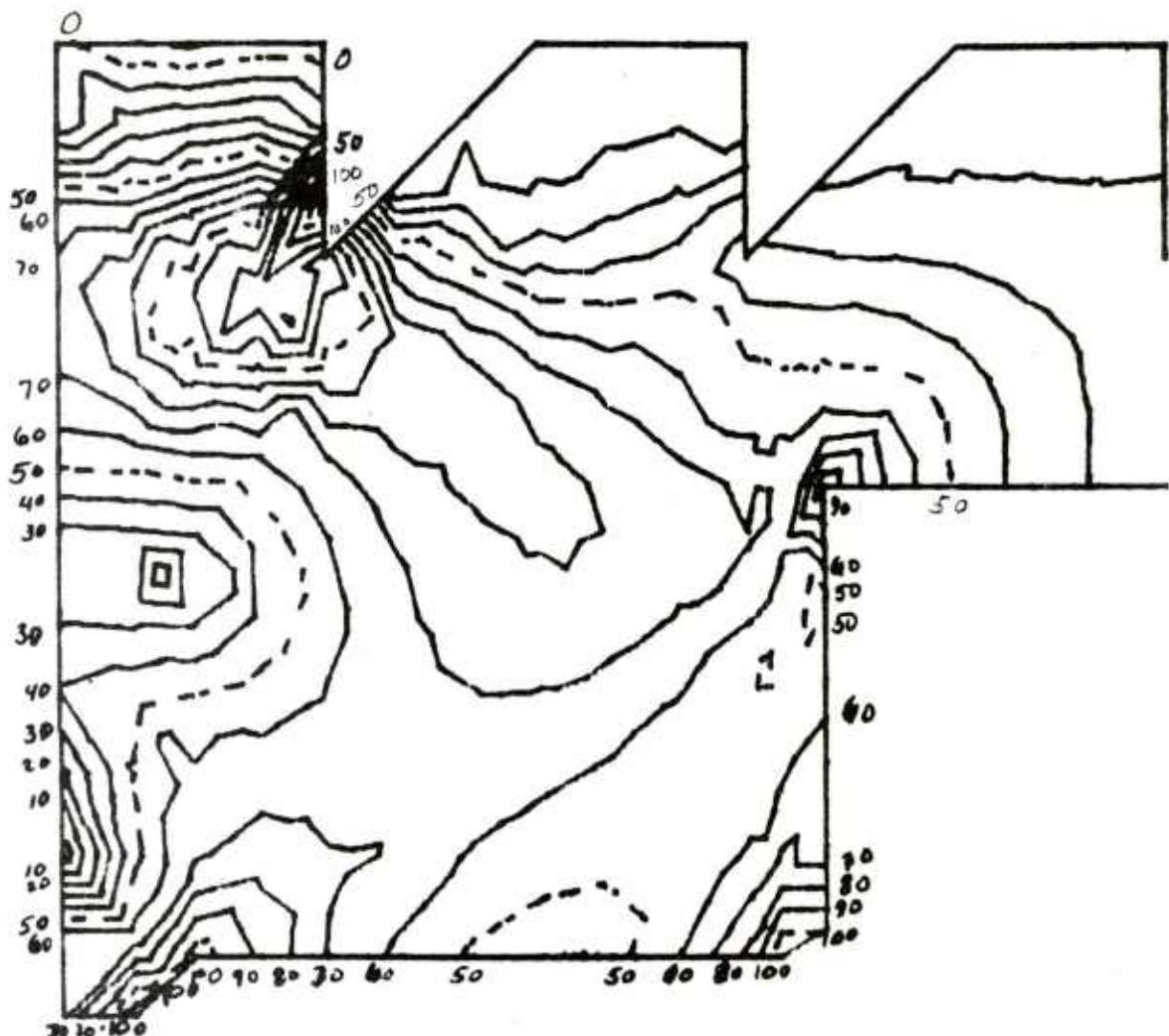


Figure 3. Stress plot - Run 1.

## RUN 2

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****			STRESSES(KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES		
1	2.52	.69	5.28	4.61	-7.30	8.41	19.04		
2	2.31	.70	13.51	-29.03	-16.78	-3.23	38.34		
3	2.10	.70	6.94	-91.69	-42.60	-13.75	88.68		
4	1.89	.70	-7.11	-120.50	-63.61	-8.44	99.28		
5	1.67	.70	-20.25	-118.15	-75.33	-10.99	87.11		
6	1.46	.70	-25.46	-91.21	-79.10	2.62	60.77		
7	1.25	.70	-23.45	-30.25	-70.54	1.52	44.17		
8	1.04	.70	-44.44	-23.84	-82.89	-31.69	75.55		
9	.83	.71	-92.18	-83.29	-125.56	-35.03	71.91		
10	.62	.71	-130.70	-114.85	-160.43	-15.06	47.81		
11	.41	.71	-147.72	-114.70	-181.50	-11.49	61.17		
12	.20	.71	-119.04	-99.07	-219.11	-18.00	115.68		
13	2.52	.87	-.75	9.98	3.43	9.48	18.91		
14	2.30	.87	3.89	-43.85	-11.77	1.49	42.23		
15	2.09	.87	11.03	-97.64	-29.55	-18.19	100.20		
16	1.88	.87	5.08	-119.13	-44.70	-26.92	117.88		
17	1.66	.87	-7.20	-110.26	-53.35	-21.50	96.85		
18	1.45	.87	-16.94	-80.69	-55.36	-12.51	59.67		
19	1.24	.88	-38.84	-44.20	-57.02	-23.27	43.42		
20	1.02	.88	-57.81	-40.61	-63.49	-51.19	91.04		
21	.81	.88	-65.92	-69.47	-76.31	-56.88	98.95		
22	.60	.88	-77.28	-94.94	-92.82	-38.94	69.48		
23	.38	.88	-79.66	-102.69	-108.42	-32.64	62.39		
24	.18	.84	-90.03	-121.00	-157.56	-37.92	88.00		
25	2.52	1.03	-1.96	17.50	13.67	8.12	22.73		
26	2.30	1.04	-2.27	-58.79	-8.52	9.31	56.04		
27	2.09	1.04	13.09	-113.80	-23.72	-19.11	117.82		
28	1.87	1.04	-1.97	-118.84	-35.74	-43.26	128.33		
29	1.65	1.04	-8.29	-97.30	-35.67	-28.67	93.28		
30	1.44	1.04	-12.63	-80.12	-36.86	-27.37	75.87		
31	1.22	1.04	-28.92	-55.59	-38.09	-43.39	78.74		
32	1.01	1.04	-40.88	-42.04	-37.89	-60.40	104.68		
33	.79	1.05	-45.23	-51.14	-40.35	-59.94	104.24		
34	.57	1.05	-43.32	-70.91	-45.30	-42.46	77.88		
35	.36	1.05	-34.96	-100.36	-55.18	-26.91	74.40		
36	2.52	1.21	-3.72	24.35	20.19	3.54	26.94		
37	2.30	1.21	-15.47	-55.93	-5.43	8.97	48.84		
38	2.11	1.21	-21.59	-168.91	-41.09	-3.19	138.71		
39	1.89	1.21	-20.99	-111.30	-27.55	-54.80	128.90		
40	1.65	1.22	-1.91	-84.51	-14.06	-23.04	86.95		
41	1.44	1.22	-2.70	-88.69	-19.04	-37.81	102.68		
42	1.22	1.22	-13.33	-61.27	-16.50	-56.41	108.19		
43	1.01	1.22	-21.41	-36.00	-10.01	-63.28	111.90		
44	.79	1.22	-17.54	-27.75	-1.80	-57.27	101.74		
45	.57	1.22	-15.35	-43.22	1.62	-36.39	74.23		
46	.36	1.23	-5.27	-68.80	5.29	-11.63	72.28		
47	2.11	1.44	23.68	106.37	61.63	22.11	81.28		
48	1.94	1.39	7.10	9.80	31.51	-50.00	89.66		
49	1.70	1.40	-5.73	-99.12	-5.04	-26.33	104.24		
50	1.50	1.40	-3.92	-106.06	-6.20	-33.76	116.72		

## CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****				STRESSES (KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES			
51	1.29	1.40	-2.93	-77.12	2.12	-58.30	126.88			
52	1.08	1.40	-6.66	-26.37	19.18	-60.70	112.33			
53	.87	1.40	10.15	-9.75	36.49	-47.12	90.96			
54	.66	1.40	26.96	-5.06	51.17	-35.58	78.65			
55	.51	1.45	26.66	-24.59	60.90	-20.46	82.52			
56	.35	1.41	17.83	-52.61	65.69	2.22	103.14			
57	2.24	1.58	-5.44	15.72	28.12	7.23	31.95			
58	2.03	1.58	-9.42	24.75	35.33	-25.85	60.38			
59	1.82	1.58	-5.68	-41.35	21.62	-40.73	89.27			
60	1.61	1.58	-20.53	-99.99	3.56	-31.23	108.32			
61	1.42	1.58	-35.03	-126.91	-4.36	-44.71	134.90			
62	1.21	1.57	-34.33	-32.12	32.08	-51.54	110.62			
63	.99	1.58	42.59	.83	79.74	-16.94	74.40			
64	.78	1.58	77.22	-1.80	98.12	-20.38	97.87			
65	.58	1.58	113.63	28.89	121.96	-32.03	105.04			
66	.37	1.59	49.20	-50.35	102.11	-3.79	134.24			
67	2.47	1.81	-.20	5.67	26.20	3.46	24.75			
68	2.32	1.76	-3.53	7.21	27.97	.07	27.74			
69	2.10	1.77	-18.73	1.47	26.69	-15.07	47.27			
70	1.88	1.77	-19.36	-26.94	24.90	-39.24	83.49			
71	1.67	1.77	-24.17	-76.59	15.27	-45.47	112.13			
72	1.47	1.76	-38.51	-176.16	-12.43	-51.83	176.86			
73	.38	1.77	33.99	-3.53	86.69	-34.65	98.81			
74	2.52	1.95	-1.46	3.88	26.35	1.03	25.63			
75	2.30	1.95	-7.42	-2.08	26.40	-5.09	32.71			
76	2.09	1.95	-13.17	-13.88	25.88	-19.68	52.10			
77	1.87	1.95	-17.12	-36.64	23.71	-36.95	83.31			
78	1.66	1.95	-16.98	-78.89	17.43	-42.88	112.54			
79	1.47	1.95	-.54	-118.14	14.34	-21.10	130.91			
80	.38	1.96	-3.75	-.45	24.36	-6.26	28.73			
81	2.52	2.13	-1.66	2.52	27.12	-.49	26.95			
82	2.30	2.13	-4.56	-10.37	25.91	-5.61	35.12			
83	2.09	2.13	-5.15	-25.77	24.98	-19.99	56.16			
84	1.87	2.13	-9.60	-42.69	23.00	-35.40	83.64			
85	1.66	2.13	-6.40	-64.75	22.48	-31.95	94.80			
86	1.47	2.13	-1.15	-85.77	21.60	-12.75	100.45			
87	.38	2.14	-.24	.77	4.57	2.15	5.76			
88	2.52	2.31	-.85	.71	27.43	-.54	27.55			
89	2.30	2.31	-.25	-15.15	26.12	-3.34	36.66			
90	2.11	2.31	6.14	-43.16	22.32	-15.24	64.71			
91	1.89	2.31	-4.80	-41.63	22.25	-34.72	81.87			
92	1.66	2.31	-.58	-49.85	26.20	-23.16	77.94			
93	1.47	2.31	1.23	-63.32	26.52	-9.39	81.87			
94	.38	2.32	-.42	.59	-2.56	3.16	6.14			
95	1.98	2.44	12.40	32.05	47.07	-32.89	64.43			
96	1.74	2.44	.61	-41.78	25.14	-25.71	73.63			
97	1.58	2.46	-.16	-53.28	24.10	-18.51	75.68			
98	1.46	2.44	2.79	-47.26	30.12	-8.99	69.73			
99	.38	2.45	-.13	.39	-4.26	2.11	5.72			
100	2.10	2.54	-9.06	14.99	29.94	-15.04	42.89			

## CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****			STRESSES(KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES		
101	1.89	2.54	3.68	.16	34.59	-30.46	62.13		
102	1.68	2.54	1.58	-39.88	25.57	-20.56	67.50		
103	1.48	2.54	1.30	-42.80	28.68	-10.01	64.83		
104	.40	2.55	-.23	.16	-5.68	.86	5.85		
105	2.26	2.69	-8.40	-.37	19.94	-7.85	28.72		
106	2.11	2.73	-6.62	5.53	24.18	-10.52	32.47		
107	1.95	2.69	-8.31	-2.12	25.56	-19.83	46.43		
108	1.75	2.69	.60	-17.64	28.10	-21.19	54.20		
109	1.54	2.69	-1.03	-38.65	25.50	-12.39	59.82		
110	2.44	2.87	-4.38	-5.91	14.95	-4.89	21.84		
111	2.29	2.91	-2.89	-2.49	17.55	-6.66	23.30		
112	2.15	2.87	-7.33	-1.97	18.86	-8.95	28.54		
113	1.96	2.87	-6.05	-3.60	22.23	-14.23	36.65		
114	1.77	2.87	-4.55	-13.34	23.61	-15.49	42.87		
115	1.57	2.87	-2.09	-29.20	23.79	-11.06	49.72		
116	2.53	3.05	-.95	-8.04	12.93	-3.46	19.42		
117	2.34	3.05	-2.80	-6.11	14.51	-6.40	22.15		
118	2.15	3.05	-3.32	-3.41	17.31	-8.79	25.67		
119	1.96	3.05	-3.76	-5.13	19.38	-10.73	30.24		
120	1.76	3.05	-2.13	-10.88	21.32	-10.94	34.52		
121	1.57	3.05	-.21	-17.32	23.44	-5.84	36.87		
122	2.53	3.23	.12	-12.87	10.47	-3.06	20.95		
123	2.34	3.23	.66	-7.43	13.45	-6.35	21.29		
124	2.15	3.23	-.28	-4.36	15.72	-7.67	22.69		
125	1.96	3.23	.44	-4.70	17.93	-8.11	24.89		
126	1.76	3.23	.63	-7.97	19.44	-7.43	27.48		
127	1.57	3.23	.63	-9.97	21.77	-3.31	28.57		
128	2.53	3.41	.62	-16.29	8.76	-1.29	22.24		
129	2.34	3.41	4.00	-9.95	12.58	-3.42	20.57		
130	2.15	3.41	10.32	-3.96	17.09	-7.02	22.23		
131	1.96	3.41	3.89	-4.44	16.23	-7.77	22.48		
132	1.76	3.41	2.43	-4.86	17.57	-6.00	22.38		
133	1.57	3.41	1.00	-5.00	19.57	-2.47	22.60		
134	2.11	3.64	-4.19	1.03	10.37	-7.98	18.83		
135	1.96	3.59	2.78	1.19	14.53	-9.69	20.99		
136	1.77	3.59	1.98	-1.76	15.02	-5.87	18.33		
137	1.57	3.59	.92	-.62	17.22	-2.27	17.57		
138	2.30	3.83	-3.94	-6.08	4.54	-5.49	13.60		
139	2.15	3.78	-4.25	-2.22	6.77	-3.01	11.43		
140	1.96	3.78	-1.71	1.64	10.19	-5.03	13.74		
141	1.77	3.78	.68	1.82	12.56	-4.33	13.61		
142	1.57	3.78	.58	3.09	14.83	-1.73	13.51		
143	2.48	4.01	-1.13	-4.17	3.84	-2.98	8.70		
144	2.34	3.96	-1.94	-3.96	4.34	-3.14	9.26		
145	2.15	3.96	-1.44	-1.44	5.98	-2.26	8.39		
146	1.96	3.96	-1.10	1.40	7.96	-2.19	8.94		
147	1.76	3.96	.05	3.24	10.15	-1.96	9.56		
148	1.57	3.96	.38	5.50	12.56	-.82	10.69		
149	2.53	4.15	-.37	-4.78	2.97	-1.98	7.56		
150	2.34	4.15	-.08	-3.30	3.85	-2.71	7.77		

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				MISFS
	R	Z	RR	ZZ	TT	RZ	
151	2.15	4.15	-.24	-.53	5.14	-1.79	6.34
152	1.95	4.15	-.04	1.97	6.70	-.84	6.16
153	1.76	4.15	.49	3.85	8.40	-.36	6.91
154	1.57	4.15	.40	6.31	10.43	-.05	8.73
155	2.53	4.33	.30	-7.05	1.64	-1.49	8.50
156	2.34	4.33	.91	-2.85	3.26	-2.50	6.88
157	2.15	4.33	.55	.84	4.62	-1.55	4.76
158	1.95	4.33	1.00	2.90	5.96	.28	4.36
159	1.76	4.33	1.22	3.98	7.05	.42	5.11
160	1.57	4.33	.48	6.16	8.49	.20	7.15
161	2.53	4.51	.41	-8.54	.71	-.58	9.16
162	2.34	4.51	2.08	-3.36	2.84	-1.33	6.29
163	2.15	4.51	4.25	3.01	5.47	-1.97	4.03
164	1.95	4.51	2.43	3.67	5.50	1.01	3.19
165	1.76	4.51	1.27	3.45	5.51	.16	3.69
166	1.57	4.51	.47	5.95	6.81	.09	5.96
167	2.11	4.74	-1.68	-4.15	.32	-2.77	6.17
168	1.96	4.09	.56	.03	2.59	.29	2.39
169	1.76	4.69	.70	3.80	4.19	-.03	3.31
170	1.57	4.69	.28	5.83	5.29	.01	5.30
171	2.30	4.93	-.97	-1.87	.25	-1.53	3.23
172	2.15	4.88	-.45	-1.29	.80	-.58	2.08
173	1.96	4.88	-.06	.72	1.67	.67	1.90
174	1.77	4.88	.07	3.41	2.83	.57	3.24
175	1.57	4.88	.14	5.69	4.02	.20	4.94
176	2.48	5.11	-.26	-1.08	.18	-.78	1.75
177	2.34	5.06	-.35	-1.04	.27	-.68	1.64
178	2.15	5.06	.07	-.28	.69	-.01	.85
179	1.96	5.06	.18	1.22	1.26	.77	1.71
180	1.76	5.06	.16	3.11	2.02	.89	3.02
181	1.57	5.06	.09	5.10	2.94	.44	4.42
182	2.53	5.25	-.06	-1.18	-.05	-.48	1.40
183	2.34	5.25	.13	-.59	.18	-.48	1.12
184	2.15	5.25	.18	.44	.52	.17	.43
185	1.95	5.25	.24	1.62	.96	.88	1.94
186	1.76	5.25	.27	2.87	1.47	1.02	2.87
187	1.57	5.25	.12	4.29	2.08	.52	3.72
188	2.53	5.43	.11	-1.67	-.40	-.34	1.69
189	2.34	5.43	.30	-.22	.05	-.45	.90
190	2.15	5.43	.15	1.18	.43	.16	.96
191	1.95	5.43	.30	1.99	.78	1.12	2.46
192	1.76	5.43	.43	2.52	1.04	1.04	2.59
193	1.57	5.43	.12	3.46	1.36	.44	3.02
194	2.53	5.61	.12	-1.98	-.63	-.13	1.86
195	2.34	5.61	.53	-.21	-.05	-.26	.80
196	2.15	5.61	.86	2.25	.73	-.18	1.50
197	1.96	5.61	.71	2.33	.77	1.50	3.05
198	1.76	5.61	.28	1.83	.46	.75	1.96
199	1.57	5.61	.09	2.83	.78	.31	2.52
200	2.11	5.84	-.47	-2.60	-1.31	-.53	2.08

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		*****		STRESSES (KPSI)		*****	
	R	Z	RR	ZZ	TT	RZ	MISES	
201	1.96	5.79	-.17	-.48	-.65	1.32	2.33	
202	1.76	5.79	.04	1.65	.06	.65	1.96	
203	1.57	5.79	.00	2.28	.25	.26	2.21	
204	2.30	6.03	-.12	-.30	-.59	-.21	.55	
205	2.15	5.98	.19	-.57	-.61	-.05	.78	
206	1.96	5.98	.05	-.17	-.65	.92	1.72	
207	1.77	5.98	-.15	1.01	-.41	.81	1.92	
208	1.57	5.98	-.03	1.78	-.17	.31	1.96	
209	2.48	6.21	-.04	-.14	-.58	-.14	.55	
210	2.34	6.16	-.05	-.15	-.61	-.10	.55	
211	2.15	6.16	.08	-.11	-.63	.15	.69	
212	1.96	6.16	.09	.19	-.63	.61	1.32	
213	1.76	6.16	-.03	.71	-.60	.71	1.67	
214	1.57	6.16	-.04	1.18	-.54	.35	1.65	
215	2.53	6.35	-.00	-.20	-.65	-.12	.61	
216	2.34	6.35	.02	-.01	-.65	-.12	.69	
217	2.15	6.35	.02	.23	-.66	.15	.84	
218	1.95	6.35	.02	.41	-.69	.51	1.30	
219	1.76	6.35	.01	.55	-.75	.59	1.52	
220	1.57	6.35	-.01	.64	-.84	.30	1.38	
221	2.53	6.53	.04	-.36	-.76	-.12	.73	
222	2.34	6.53	.12	.12	-.68	-.19	.86	
223	2.15	6.53	.03	.56	-.66	.03	1.06	
224	1.95	6.53	.04	.60	-.72	.50	1.44	
225	1.76	6.53	.11	.37	-.89	.47	1.41	
226	1.57	6.53	-.00	.22	-1.12	.17	1.28	
227	2.53	6.71	.07	-.49	-.84	-.06	.80	
228	2.34	6.71	.30	.07	-.70	-.13	.94	
229	2.15	6.71	.58	.99	-.46	-.21	1.35	
230	1.95	6.71	.44	.81	-.66	.55	1.63	
231	1.76	6.71	.01	.02	-1.20	.15	1.24	
232	1.57	6.71	-.05	.03	-1.40	.02	1.39	

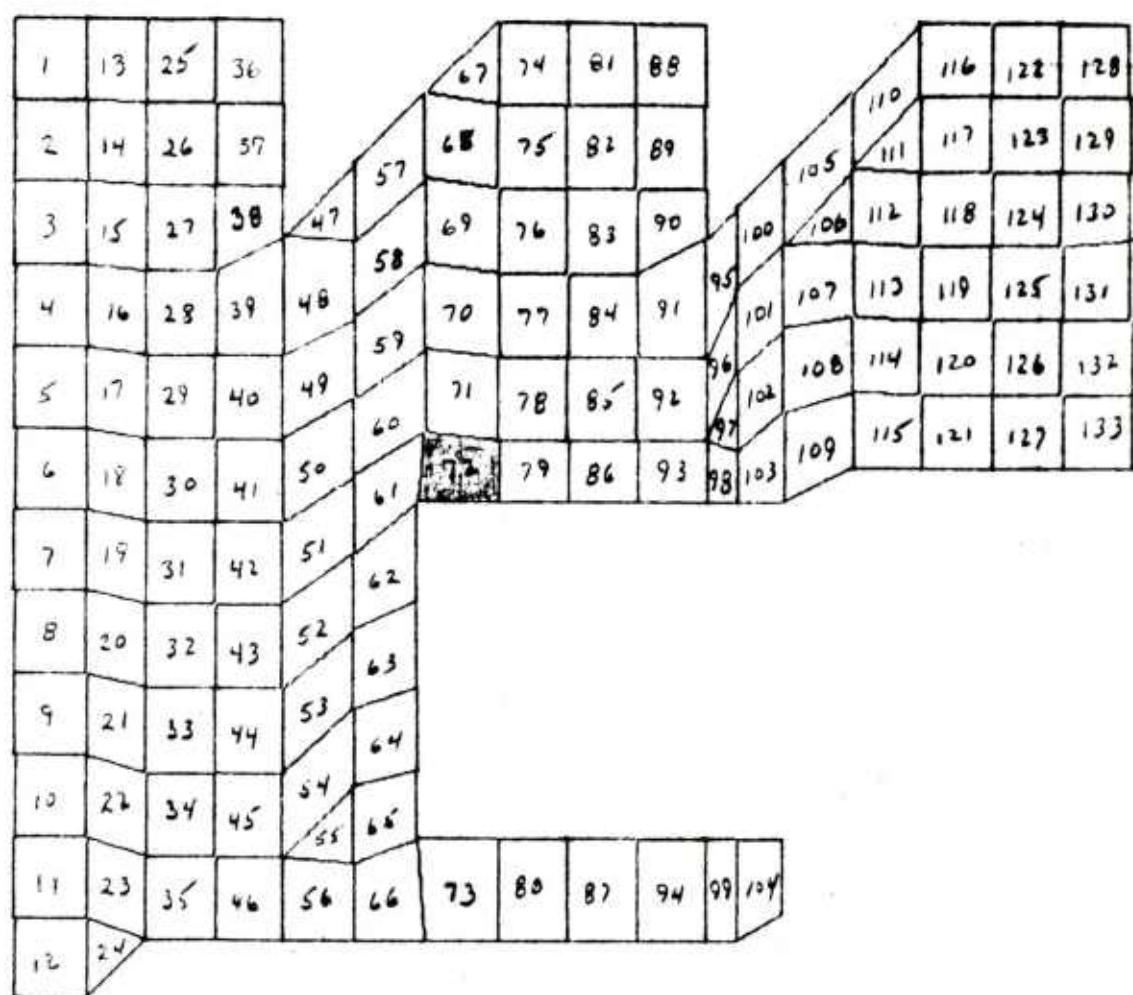


Figure 4. Geometry plot - Run 2.

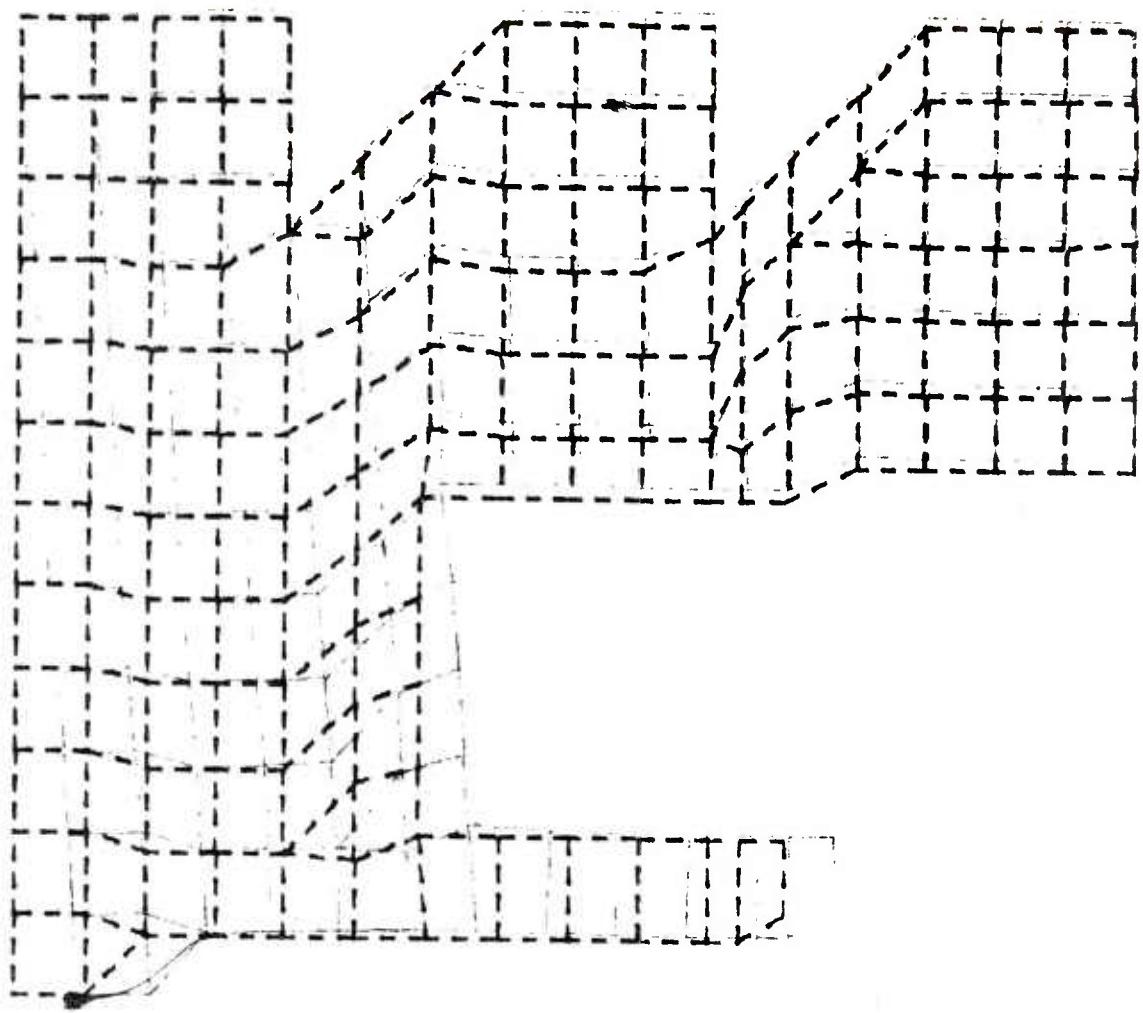


Figure 5. Distortion plot - Run 2.

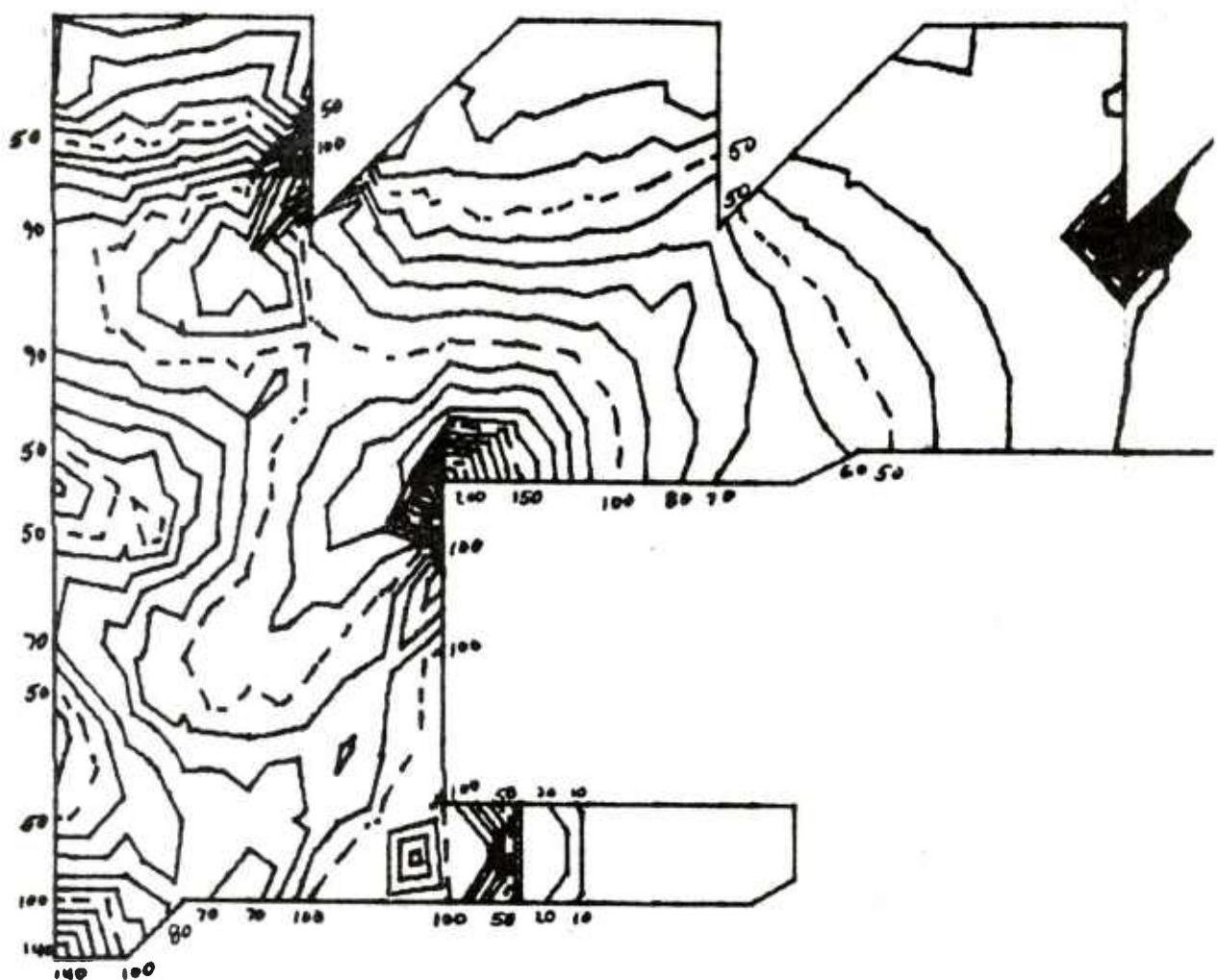


Figure 6. Stress plot - Run 2.

## RUN 3

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES			STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ		
1	2.62	.60	5.28	4.61	-7.30	8.41		19.04
2	2.41	.60	13.51	-29.03	-16.78	-3.23		38.34
3	2.20	.60	6.94	-91.69	-42.60	-13.75		88.68
4	1.99	.60	-7.11	-120.50	-63.61	-8.44		99.28
5	1.78	.60	-20.25	-118.15	-75.33	-10.99		87.11
6	1.57	.61	-25.46	-91.21	-79.10	2.62		60.77
7	1.36	.61	-23.45	-30.25	-70.54	1.52		44.16
8	1.15	.61	-44.44	-23.84	-82.88	-31.69		75.55
9	.93	.61	-92.18	-83.29	-125.56	-35.03		71.91
10	.72	.61	-130.70	-114.85	-160.43	-15.06		47.81
11	.51	.61	-147.71	-114.70	-181.50	-11.49		61.17
12	.30	.62	-119.04	-99.07	-219.11	-18.00		115.68
13	.09	.62	-0.75	9.98	3.43	9.48		18.91
14	2.62	.79	3.89	-43.85	-11.77	1.49		42.23
15	2.41	.79	11.03	-97.64	-29.55	-18.19		100.20
16	2.20	.79	5.08	-119.13	-44.70	-26.92		117.88
17	1.99	.79	-7.20	-110.26	-53.35	-21.50		96.85
18	1.78	.79	-16.94	-80.69	-55.36	-12.51		59.67
19	1.57	.80	-38.84	-44.20	-57.02	-23.26		43.42
20	1.36	.80	-57.81	-40.61	-63.49	-51.19		91.03
21	1.15	.80	-65.92	-69.47	-76.31	-56.88		98.95
22	.94	.80	-77.28	-94.94	-92.82	-38.94		69.48
23	.73	.80	-79.66	-102.69	-108.42	-32.64		62.39
24	.53	.80	-90.03	-121.00	-157.56	-37.92		88.00
25	.30	.81	-1.96	17.50	13.67	8.12		22.73
26	.09	.81	-2.27	-58.75	-8.52	9.31		56.04
27	2.63	.95	13.09	-113.80	-23.72	-19.11		117.82
28	2.41	.95	-1.97	-118.84	-35.74	-43.26		128.33
29	2.19	.95	-8.29	-97.30	-35.67	-28.67		93.28
30	1.98	.95	-12.63	-80.12	-36.86	-27.37		75.87
31	1.76	.95	-28.92	-55.59	-38.09	-43.39		78.74
32	1.54	.95	-40.88	-42.04	-37.89	-60.40		104.68
33	1.33	.95	-45.23	-51.14	-40.35	-59.94		104.24
34	1.11	.96	-45.32	-70.91	-45.30	-42.46		77.87
35	.90	.96	-34.96	-100.36	-55.18	-26.91		74.40
36	.68	.96	-3.72	24.34	20.19	3.54		26.94
37	.47	.96	-15.47	-55.93	-5.43	8.97		48.84
38	.25	.96	-21.59	-168.91	-41.09	-3.19		138.71
39	2.63	1.12	-20.99	-111.30	-27.55	-54.80		128.90
40	2.41	1.12	-1.91	-84.51	-14.06	-23.04		86.95
41	2.19	1.12	-2.70	-88.69	-19.04	-37.81		102.68
42	1.98	1.12	-13.33	-61.27	-16.50	-56.41		108.19
43	1.76	1.13	-21.41	-36.00	-10.01	-63.28		111.90
44	1.55	1.13	-17.54	-27.75	-1.80	-57.27		101.74
45	1.33	1.13	-15.35	-43.22	1.62	-36.39		74.23
46	1.11	1.13	-5.27	-68.80	5.29	-11.63		72.28
47	.90	1.13	23.68	106.37	61.63	22.11		81.28
48	.68	1.14	7.10	9.80	31.51	-50.00		89.66
49	.47	1.14	-5.73	-99.12	-5.04	-26.33		104.24
50	.25	1.14	-3.92	-106.06	-6.20	-33.76		116.72

## RUN 3

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				
	R	Z	RR	ZZ	TT	RZ	MISES
51	2.63	1.30	-2.93	-77.12	2.12	-58.30	126.88
52	2.41	1.30	-6.66	-26.37	19.18	-60.70	112.33
53	2.19	1.30	10.15	-9.75	36.49	-47.12	90.96
54	2.07	1.30	26.96	-5.06	51.17	-35.58	78.65
55	1.76	1.30	26.66	-24.59	60.90	-20.46	82.52
56	1.55	1.30	17.83	-52.61	65.69	2.22	103.14
57	1.33	1.31	-5.44	15.72	28.12	7.23	31.95
58	1.11	1.31	-9.42	24.75	35.33	-25.85	60.38
59	0.90	1.31	-5.68	-41.35	21.62	-40.73	89.27
60	0.68	1.31	-20.53	-99.99	3.56	-31.23	108.32
61	0.47	1.31	-35.03	-126.91	-4.36	-44.71	134.90
62	0.25	1.31	-34.33	-32.12	32.08	-51.54	110.62
63	2.26	1.49	42.59	0.83	79.74	-16.94	74.40
64	2.05	1.49	77.22	-1.80	98.12	-20.38	97.87
65	1.85	1.49	113.63	28.89	121.96	-32.03	105.04
66	1.65	1.49	49.20	-50.35	102.11	-3.79	134.24
67	1.45	1.49	-0.20	5.67	26.20	3.46	24.75
68	1.25	1.49	-3.53	7.21	27.97	0.07	27.74
69	1.05	1.49	-18.73	1.47	26.69	-15.07	47.27
70	0.85	1.50	-19.36	-26.94	24.90	-39.24	83.49
71	0.65	1.50	-24.17	-76.59	15.27	-45.47	112.13
72	0.45	1.50	-38.51	-176.18	-12.43	-51.83	176.85
73	0.25	1.50	0.0	0.0	0.0	0.0	0.0
74	2.44	1.67	0.0	0.0	0.0	0.0	0.0
75	2.22	1.67	0.0	0.0	0.0	0.0	0.0
76	2.00	1.67	0.0	0.0	0.0	0.0	0.0
77	1.78	1.67	33.99	-3.53	86.68	-34.65	98.81
78	1.57	1.67	-1.46	3.88	26.35	1.03	25.63
79	1.39	1.65	-7.42	-2.08	26.40	-5.09	32.71
80	1.13	1.66	-13.17	-13.88	25.88	-19.68	52.10
81	0.91	1.66	-17.12	-36.64	23.71	-36.95	83.31
82	0.69	1.66	-16.98	-78.89	17.43	-42.88	112.54
83	0.52	1.66	-0.54	-118.14	14.34	-21.10	130.91
84	0.25	1.68	0.0	0.0	0.0	0.0	0.0
85	2.63	1.86	0.0	0.0	0.0	0.0	0.0
86	2.41	1.86	0.0	0.0	0.0	0.0	0.0
87	2.20	1.86	0.0	0.0	0.0	0.0	0.0
88	1.98	1.86	-3.75	-0.45	24.36	-6.26	28.73
89	1.76	1.86	-1.66	2.52	27.12	-0.49	26.95
90	1.55	1.86	-4.56	-10.37	25.91	-5.61	35.12
91	1.39	1.86	-5.15	-25.77	24.98	-19.99	56.16
92	1.11	1.86	-9.60	-42.69	23.00	-35.40	83.64
93	0.90	1.86	-6.40	-64.75	22.48	-31.95	94.80
94	0.68	1.86	-1.15	-85.77	21.60	-12.75	100.45
95	0.52	1.87	0.0	0.0	0.0	0.0	0.0
96	0.25	1.87	0.0	0.0	0.0	0.0	0.0
97	2.63	2.04	0.0	0.0	0.0	0.0	0.0
98	2.41	2.04	0.0	0.0	0.0	0.0	0.0
99	2.20	2.04	-0.24	0.77	4.57	2.15	5.76
100	1.98	2.04	-0.85	0.71	27.43	-0.54	27.55

## RUN 3

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				
	R	Z	RR	ZZ	TT	RZ	MISES
101	1.76	2.04	-0.25	-15.15	26.12	-3.34	36.66
102	1.55	2.04	6.14	-43.16	22.32	-15.24	64.71
103	1.39	2.04	-4.80	-41.63	22.25	-34.72	81.86
104	1.11	2.04	-0.58	-49.85	26.20	-23.16	77.94
105	0.90	2.04	1.23	-63.32	26.52	-9.39	81.87
106	0.68	2.04	0.0	0.0	0.0	0.0	0.0
107	0.52	2.05	0.0	0.0	0.0	0.0	0.0
108	0.25	2.05	0.0	0.0	0.0	0.0	0.0
109	2.63	2.22	0.0	0.0	0.0	0.0	0.0
110	2.41	2.22	-0.42	0.59	-2.56	3.16	6.14
111	2.20	2.22	12.40	32.05	47.07	-32.89	64.43
112	1.98	2.22	0.61	-41.78	25.13	-25.71	73.63
113	1.76	2.22	-0.16	-53.28	24.10	-18.51	75.68
114	1.55	2.22	2.79	-47.26	30.12	-8.99	69.73
115	1.39	2.22	0.0	0.0	0.0	0.0	0.0
116	1.11	2.22	0.0	0.0	0.0	0.0	0.0
117	0.90	2.22	0.0	0.0	0.0	0.0	0.0
118	0.68	2.22	0.0	0.0	0.0	0.0	0.0
119	0.52	2.23	-0.13	0.39	-4.26	2.11	5.72
120	0.25	2.23	-9.06	14.99	29.94	-15.04	42.89
121	2.63	2.40	3.68	0.16	34.59	-30.46	62.13
122	2.41	2.40	1.58	-39.88	25.57	-20.56	67.50
123	2.20	2.40	1.30	-42.80	28.68	-10.01	64.83
124	2.07	2.40	0.0	0.0	0.0	0.0	0.0
125	1.76	2.40	0.0	0.0	0.0	0.0	0.0
126	1.55	2.40	0.0	0.0	0.0	0.0	0.0
127	1.39	2.40	0.0	0.0	0.0	0.0	0.0
128	1.11	2.40	-0.23	0.15	-5.68	0.86	5.85
129	0.90	2.40	-8.40	-0.37	19.94	-7.85	28.72
130	0.68	2.40	-6.62	5.53	24.18	-10.52	32.47
131	0.51	2.41	-8.31	-2.12	25.56	-19.83	46.43
132	0.25	2.41	0.60	-17.64	28.10	-21.19	54.20
133	2.15	2.48	-1.03	-38.65	25.50	-12.39	59.81
134	1.94	2.48	-4.38	-5.91	14.95	-4.89	21.84
135	1.73	2.48	-2.89	-2.49	17.55	-6.66	23.29
136	1.52	2.48	-7.33	-1.97	18.86	-8.95	28.54
137	1.39	2.48	-6.05	-3.60	22.22	-14.23	36.65
138	1.09	2.48	-4.55	-13.34	23.61	-15.49	42.87
139	0.88	2.48	-2.09	-29.20	23.78	-11.06	49.72
140	0.67	2.48	-0.95	-8.04	12.93	-3.46	19.42
141	0.51	2.49	-2.80	-6.11	14.51	-6.40	22.15
142	0.25	2.49	-3.32	-3.41	17.31	-8.79	25.67
143	2.27	2.60	-3.76	-5.13	19.38	-10.73	30.24
144	2.05	2.60	-2.13	-10.88	21.32	-10.94	34.52
145	1.84	2.60	-0.21	-17.32	23.44	-5.84	36.87
146	1.62	2.60	0.12	-12.87	10.47	-3.06	20.95
147	1.39	2.60	0.66	-7.43	13.45	-6.35	21.29
148	1.19	2.60	-0.28	-4.36	15.72	-7.67	22.69
149	0.87	2.60	0.44	-4.70	17.93	-8.11	24.89
150	0.75	2.60	0.63	-7.97	19.44	-7.43	27.48

## RUN 3

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ	
151	0.51	2.61	0.63	-9.97	21.77	-3.31	28.57
152	0.32	2.61	0.62	-16.29	8.76	-1.29	22.24
153	2.45	2.78	4.00	-9.95	12.58	-3.42	20.57
154	2.25	2.78	1.32	-3.96	17.09	-7.02	22.23
155	2.06	2.78	3.89	-4.44	16.23	-7.77	22.48
156	1.87	2.78	2.43	-4.86	17.57	-6.00	22.38
157	1.67	2.78	1.00	-5.00	19.57	-2.47	22.60
158	1.48	2.78	-4.19	1.03	10.37	-7.98	18.83
159	2.63	2.96	2.78	1.19	14.53	-9.69	20.99
160	2.43	2.96	1.98	-1.76	15.02	-5.87	18.33
161	2.24	2.96	0.92	-0.62	17.22	-2.27	17.57
162	2.05	2.96	-3.94	-6.08	4.54	-5.49	13.60
163	1.86	2.96	-4.25	-2.22	6.77	-3.01	11.43
164	1.67	2.96	-1.71	1.64	10.19	-5.03	13.74
165	1.48	2.96	0.68	1.82	12.56	-4.33	13.61
166	2.63	3.14	0.58	3.09	14.83	-1.73	13.51
167	2.43	3.14	-1.13	-4.17	3.84	-2.98	8.70
168	2.24	3.14	-1.94	-3.96	4.34	-3.14	9.26
169	2.05	3.14	-1.44	-1.44	5.98	-2.26	8.39
170	1.86	3.14	-1.10	1.40	7.96	-2.19	8.94
171	1.67	3.14	0.05	3.24	10.15	-1.96	9.56
172	1.48	3.14	0.38	5.50	12.56	-0.82	10.69
173	2.63	3.32	-0.37	-4.78	2.97	-1.98	7.56
174	2.43	3.32	-0.08	-3.30	3.85	-2.71	7.77
175	2.24	3.32	-0.24	-0.53	5.14	-1.79	6.34
176	2.05	3.32	-0.04	1.97	6.70	-0.84	6.16
177	1.86	3.32	0.49	3.85	8.40	-0.36	6.91
178	1.67	3.32	0.40	6.31	10.43	-0.05	8.73
179	1.48	3.32	0.30	-7.05	1.64	-1.49	8.50
180	2.63	3.50	0.91	-2.85	3.26	-2.50	6.87
181	2.43	3.50	0.55	0.84	4.62	-1.55	4.76
182	2.24	3.50	1.00	-2.90	5.96	0.28	4.36
183	2.07	3.50	1.22	3.98	7.05	0.42	5.11
184	1.86	3.50	0.48	6.16	8.49	0.20	7.15
185	1.67	3.50	0.41	-8.54	0.71	-0.58	9.16
186	1.48	3.50	2.08	-3.36	2.84	-1.33	6.29
187	2.25	3.69	4.25	3.01	5.47	-1.97	4.03
188	2.06	3.69	2.43	3.67	5.50	1.01	3.19
189	1.86	3.69	1.27	3.45	5.51	0.16	3.69
190	1.67	3.69	0.47	5.95	6.81	0.09	5.96
191	1.48	3.69	-1.68	-4.15	0.32	-2.77	6.17
192	2.44	3.87	0.56	0.03	2.59	0.29	2.39
193	2.25	3.87	0.70	3.80	4.19	-0.03	3.31
194	2.05	3.87	0.28	5.83	5.29	0.01	5.30
195	1.86	3.87	-0.97	-1.87	0.25	-1.53	3.23
196	1.67	3.87	-0.45	-1.29	0.80	-0.58	2.08
197	1.48	3.87	-0.06	0.72	1.67	0.67	1.90
198	2.63	4.06	0.07	3.41	2.83	0.57	3.24
199	2.43	4.06	0.14	5.69	4.02	0.20	4.94
200	2.24	4.06	-0.26	-1.08	0.18	-0.78	1.75

## RUN 3

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ	
201	2.05	4.06	-0.35	-1.04	0.27	-0.68	1.64
202	1.86	4.06	0.07	-0.28	0.69	-0.01	0.85
203	1.67	4.06	0.18	1.22	1.26	0.77	1.71
204	1.48	4.06	0.16	3.11	2.02	0.89	3.02
205	2.63	4.24	0.09	5.10	2.94	0.44	4.42
206	2.43	4.24	-0.06	-1.18	-0.05	-0.48	1.40
207	2.24	4.24	0.13	-0.59	0.18	-0.48	1.12
208	2.05	4.24	0.18	0.44	0.52	0.17	0.43
209	1.86	4.24	0.24	1.62	0.96	0.88	1.94
210	1.67	4.24	0.27	2.87	1.47	1.02	2.87
211	1.48	4.24	0.12	4.29	2.08	0.52	3.72
212	2.63	4.42	0.11	-1.67	-0.40	-0.34	1.69
213	2.43	4.42	0.30	-0.22	0.05	-0.45	0.90
214	2.24	4.42	0.15	1.18	0.43	0.16	0.96
215	2.05	4.42	0.30	1.99	0.78	1.12	2.46
216	1.86	4.42	0.43	2.52	1.04	1.04	2.59
217	1.67	4.42	0.12	3.46	1.36	0.44	3.02
218	1.48	4.42	0.12	-1.93	-0.63	-0.13	1.86
219	2.63	4.60	0.53	-0.21	-0.05	-0.26	0.80
220	2.43	4.60	0.86	2.25	0.73	-0.18	1.50
221	2.24	4.60	0.71	2.33	0.77	1.50	3.05
222	2.05	4.60	0.28	1.83	0.46	0.75	1.96
223	1.86	4.60	0.09	2.83	0.78	0.31	2.52
224	1.67	4.60	-0.47	-2.60	-1.31	-0.53	2.08
225	1.48	4.60	-0.17	-0.48	-0.65	1.32	2.33
226	2.25	4.79	0.04	1.65	0.06	0.65	1.96
227	2.06	4.79	0.0	2.28	0.25	0.26	2.21
228	1.86	4.79	-0.12	-0.30	-0.59	-0.21	0.55
229	1.67	4.79	0.19	-0.57	-0.61	-0.05	0.78
230	1.48	4.79	0.05	-0.17	-0.65	0.92	1.72
231	2.44	4.97	-0.15	1.01	-0.41	0.81	1.92
232	2.25	4.97	-0.03	1.78	-0.17	0.31	1.96
233	2.05	4.97	-0.04	-0.14	-0.58	-0.14	0.55
234	1.86	4.97	-0.05	-0.15	-0.61	-0.10	0.55
235	1.67	4.97	0.08	-0.11	-0.63	0.15	0.69
236	1.48	4.97	0.09	0.19	-0.63	0.61	1.32
237	2.63	5.16	-0.03	0.71	-0.60	0.71	1.67
238	2.43	5.16	-0.04	1.18	-0.54	0.35	1.65
239	2.24	5.16	0.0	-0.20	-0.65	-0.12	0.61
240	2.05	5.16	0.02	-0.01	-0.65	-0.12	0.69
241	1.86	5.16	0.02	0.23	-0.66	0.15	0.84
242	1.67	5.16	0.02	0.41	-0.69	0.51	1.30
243	1.48	5.16	0.01	0.55	-0.75	0.59	1.52
244	2.63	5.34	-0.01	0.64	-0.84	0.30	1.38
245	2.43	5.34	0.04	-0.36	-0.76	-0.12	0.73
246	2.24	5.34	0.12	0.12	-0.68	-0.19	0.86
247	2.05	5.34	0.03	0.56	-0.66	0.03	1.06
248	1.86	5.34	0.04	0.60	-0.72	0.50	1.44
249	1.67	5.34	0.11	0.37	-0.89	0.47	1.41
250	1.48	5.34	0.0	0.22	-1.12	0.17	1.28

## RUN 3

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES			STRESSES(KPSI)			
	R	Z	RR	ZZ	TT	RZ	MISES
251	2.63	5.52	.07	-0.49	-0.84	-0.06	0.80
252	2.43	5.52	.30	0.07	-0.70	-0.13	0.94
253	2.24	5.52	.58	0.99	-0.46	-0.21	1.35
254	2.05	5.52	.44	0.81	-0.66	0.55	1.63
255	1.86	5.52	.01	0.02	-1.20	0.15	1.24
256	1.67	5.52	-0.05	0.03	-1.40	0.02	1.39

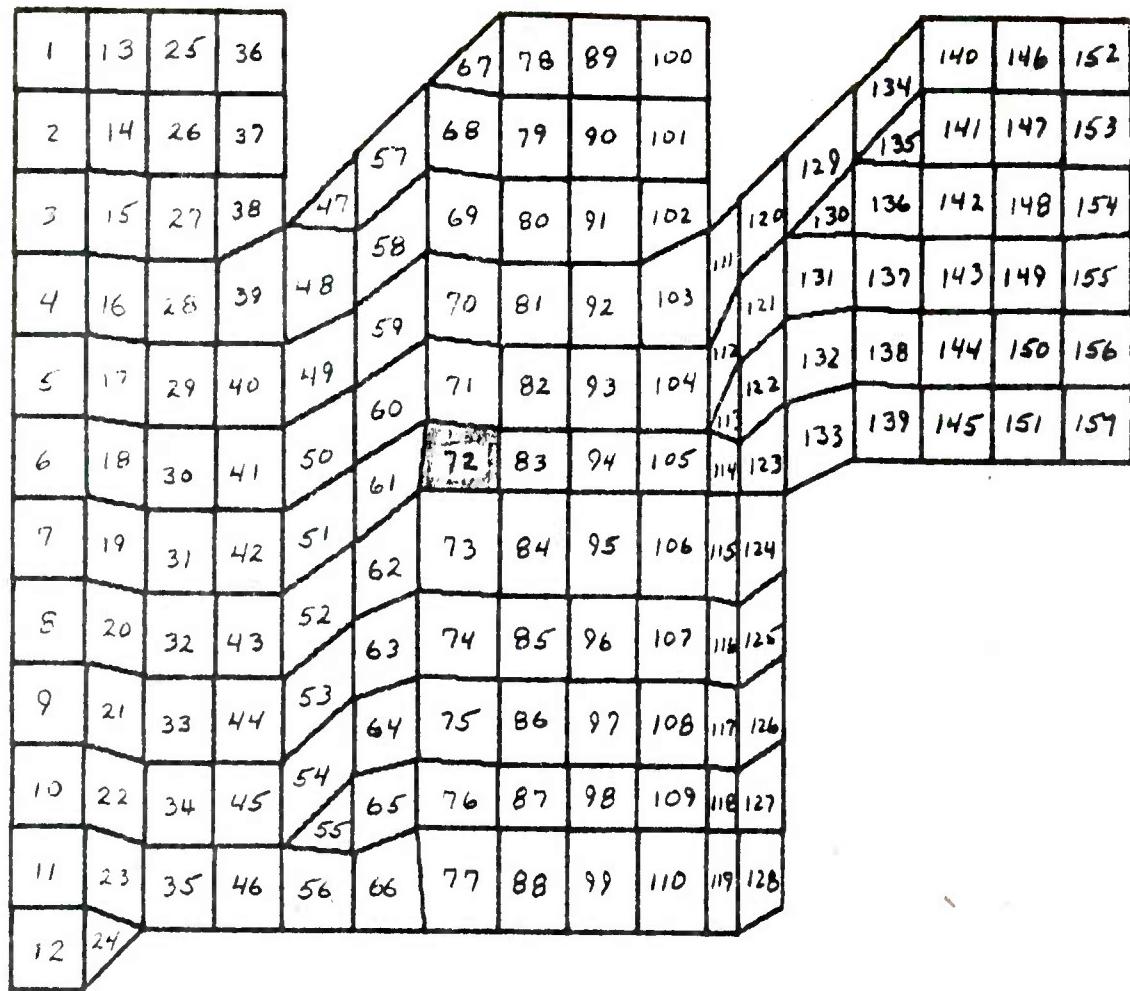


Figure 7. Geometry plot - Run 3.

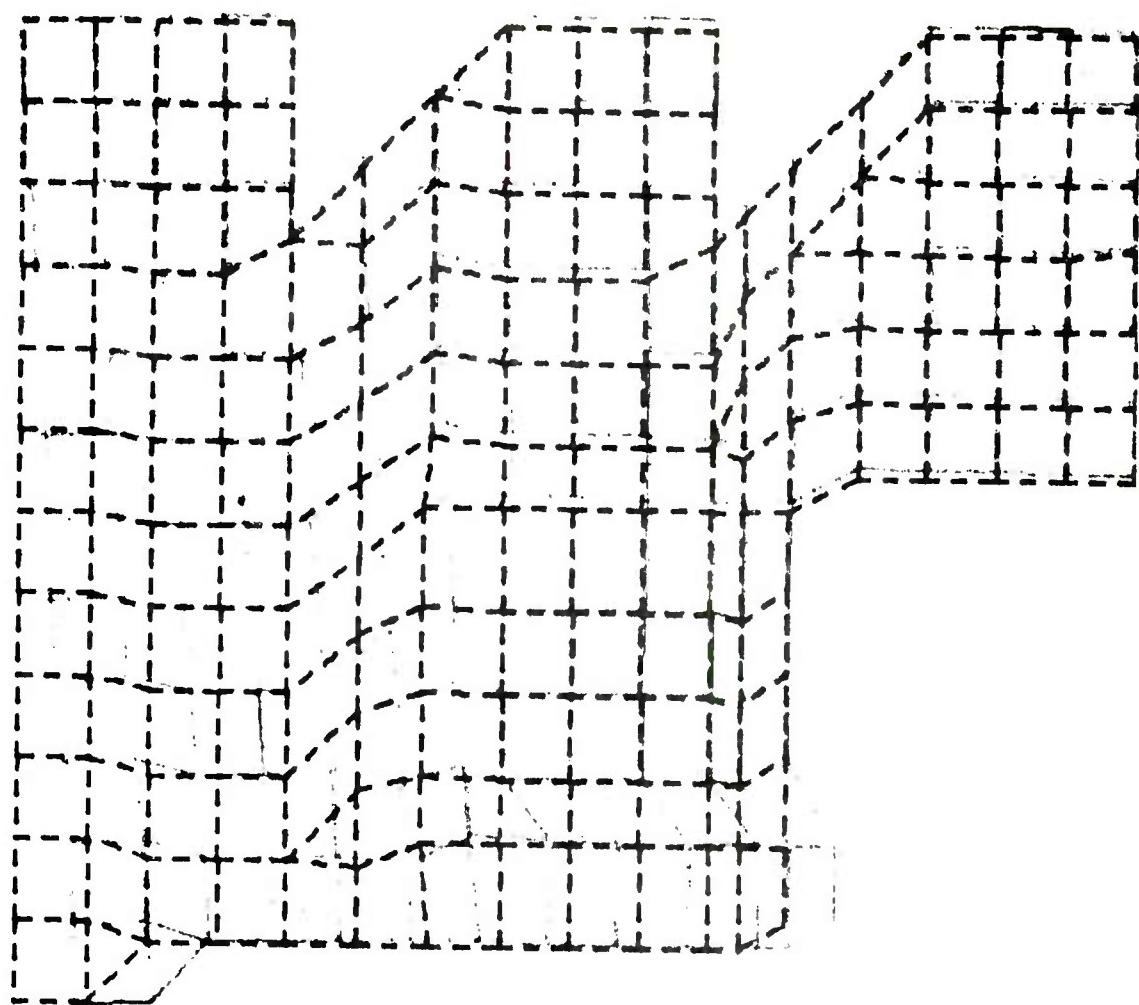


Figure 8. Distortion plot - Run 3.

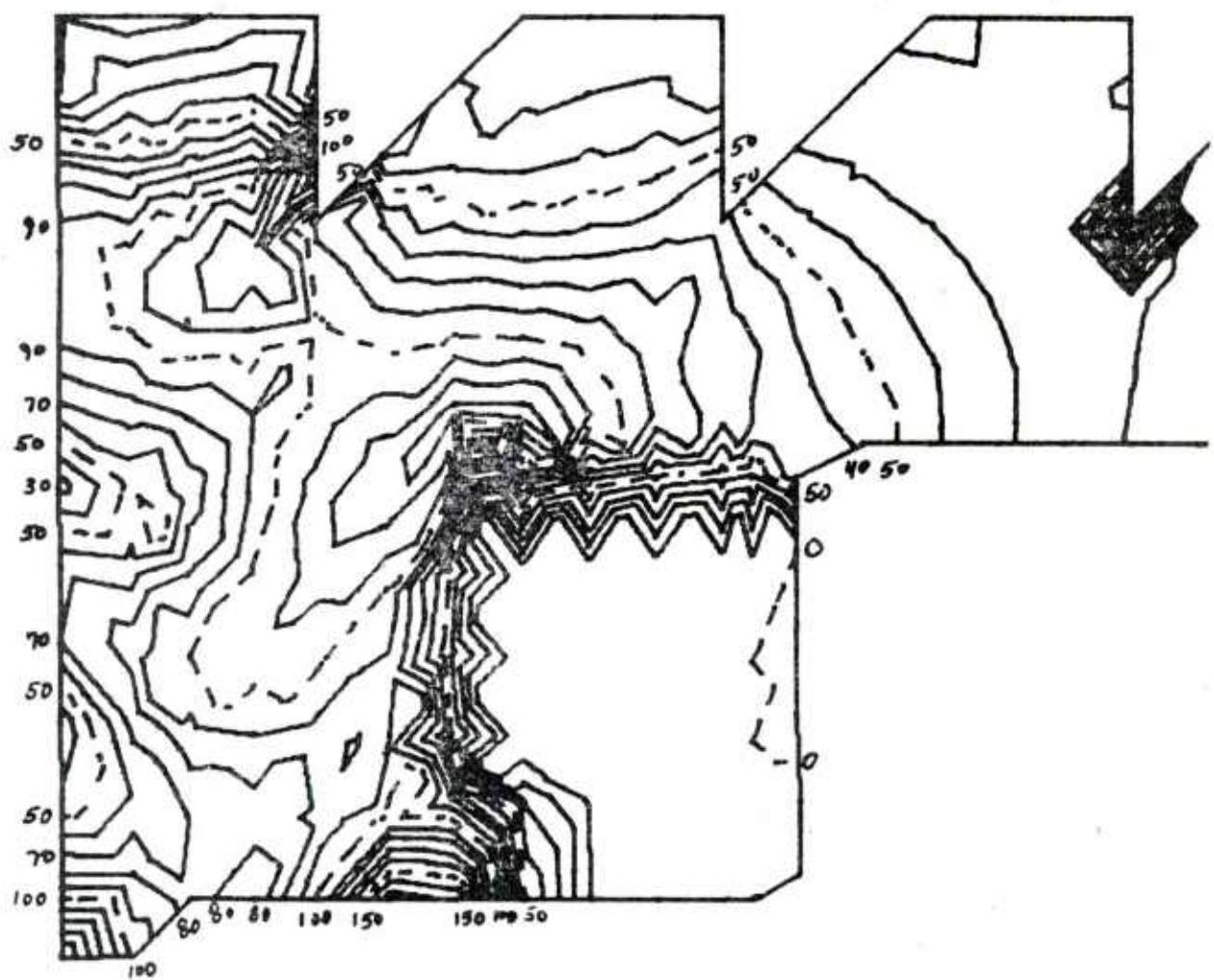


Figure 9. Stress plot - Run 3.

## RUN 4

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				
	R	Z	RR	ZZ	TT	RZ	MISES
1	2.62	0.60	3.41	3.50	-4.55	6.44	13.73
2	2.41	0.60	4.81	-29.14	-14.95	-7.52	32.28
3	2.20	0.60	-10.35	-90.90	-41.26	-16.97	76.28
4	1.99	0.60	-30.47	-119.42	-60.92	-8.85	79.79
5	1.78	0.60	-44.98	-117.02	-68.59	-7.80	65.03
6	1.57	0.60	-45.17	-90.18	-65.16	10.11	42.80
7	1.36	0.61	-30.65	-30.03	-46.48	12.75	27.37
8	1.15	0.61	-33.19	-25.16	-47.01	-18.89	37.91
9	0.94	0.61	-61.57	-85.63	-78.05	-23.45	45.87
10	0.73	0.61	-84.35	-117.39	-103.00	-6.67	30.93
11	0.51	0.61	-92.08	-117.56	-115.98	-7.01	27.54
12	0.30	0.61	-74.18	-103.18	-142.88	-17.08	66.66
13	0.09	0.61	-1.83	4.56	2.93	4.50	9.69
14	2.62	0.79	-0.87	-44.09	-11.53	-7.23	40.96
15	2.41	0.79	2.79	-93.88	-28.18	-24.44	95.40
16	2.20	0.79	-6.14	-114.08	-42.17	-27.68	106.58
17	1.99	0.79	-19.81	-104.51	-48.56	-14.71	78.84
18	1.78	0.79	-28.04	-75.52	-46.92	3.90	41.95
19	1.57	0.79	-43.26	-42.72	-43.75	1.60	2.91
20	1.36	0.79	-51.89	-45.22	-45.25	-23.31	40.92
21	1.15	0.80	-49.99	-78.96	-53.74	-32.46	62.49
22	0.94	0.80	-55.07	-106.05	-67.03	-21.97	59.83
23	0.78	0.80	-56.56	-113.40	-80.04	-22.98	63.49
24	0.51	0.80	-67.30	-132.29	-116.97	-36.39	86.23
25	0.30	0.80	-1.21	5.44	9.58	2.55	10.41
26	0.09	0.80	-0.08	-58.09	-8.81	-1.55	54.24
27	2.63	0.95	12.25	-105.96	-22.73	-26.41	114.70
28	2.41	0.95	-3.27	-108.09	-33.62	-44.73	121.36
29	2.19	0.95	-14.66	-84.46	-33.54	-22.25	73.46
30	1.98	0.95	-21.61	-68.10	-33.67	-6.96	43.50
31	1.76	0.95	-34.92	-53.37	-34.37	-10.76	26.42
32	1.54	0.95	-41.09	-53.98	-34.92	-24.85	46.22
33	1.33	0.95	-40.74	-73.32	-39.09	-31.25	63.62
34	1.11	0.95	-40.58	-94.39	-46.54	-26.44	68.61
35	0.90	0.95	-33.28	-124.00	-60.69	-23.17	90.03
36	0.68	0.95	-1.27	6.54	13.40	0.95	12.82
37	0.47	0.95	-3.25	-59.10	-6.11	1.60	54.54
38	0.25	0.96	2.16	-151.82	-34.00	-15.12	141.90
39	2.63	1.12	-12.82	-98.44	-27.80	-61.20	132.32
40	2.41	1.12	-2.55	-61.59	-14.84	-22.96	67.03
41	2.15	1.12	-11.86	-65.21	-21.16	-17.68	58.12
42	1.98	1.12	-21.14	-66.81	-22.50	-19.22	48.32
43	1.76	1.13	-27.62	-57.00	-23.94	-26.15	55.10
44	1.55	1.13	-28.76	-66.85	-26.00	-29.92	65.19
45	1.33	1.13	-27.12	-82.69	-30.12	-26.46	70.94
46	1.11	1.13	-14.29	-97.36	-37.80	-14.55	78.33
47	0.90	1.13	17.67	93.32	44.36	1.84	66.53
48	0.68	1.13	15.87	16.63	23.56	-60.75	105.48
49	0.47	1.13	4.65	-69.25	-8.19	-34.05	90.30
50	0.25	1.13	1.22	-59.42	-7.83	-26.89	73.34

ELEM NO.	COORDINATES			STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ		
51	2.63	1.30	-7.03	-57.35	-10.98	-26.29		66.50
52	2.41	1.30	-12.82	-54.74	-12.26	-28.00		64.29
53	2.19	1.30	-15.43	-57.36	-13.46	-29.04		66.14
54	2.07	1.30	-14.48	-64.23	-14.94	-26.15		67.12
55	1.76	1.30	-12.95	-72.58	-16.34	-22.66		70.04
56	1.55	1.30	-7.22	-74.89	-19.51	-11.62		65.60
57	1.33	1.30	-8.54	5.03	10.60	1.23		17.18
58	1.11	1.30	-0.89	24.44	22.10	-29.95		57.26
59	0.90	1.31	13.37	-23.58	13.45	-46.32		88.34
60	0.68	1.31	9.47	-52.93	2.36	-37.42		87.76
61	0.47	1.31	5.36	-53.25	-0.14	-33.22		80.33
62	0.25	1.31	-0.09	-51.46	-2.14	-32.29		75.27
63	2.25	1.49	-3.77	-49.27	-2.71	-31.42		71.28
64	2.05	1.49	-4.92	-50.24	-2.80	-28.41		67.64
65	1.85	1.49	-3.50	-53.96	-2.80	-21.58		63.08
66	1.65	1.49	-1.89	-57.10	-3.59	-9.42		56.78
67	1.45	1.49	0.21	0.44	12.94	2.05		13.11
68	1.25	1.49	0.16	0.20	13.66	-0.54		13.51
69	1.05	1.49	-6.82	-1.39	13.18	-12.35		27.89
70	0.85	1.49	3.31	-15.57	14.65	-35.88		67.53
71	0.65	1.49	12.01	-38.36	11.08	-40.34		85.87
72	0.45	1.49	10.66	-47.72	7.12	-37.44		86.13
73	0.25	1.49	7.80	-45.57	6.25	-36.36		82.06
74	2.44	1.67	4.94	-41.28	6.67	-33.56		74.82
75	2.22	1.67	4.00	-38.57	8.21	-28.11		66.18
76	2.80	1.67	4.75	-39.02	10.38	-19.80		58.05
77	1.78	1.67	3.82	-40.06	14.09	-8.27		51.84
78	1.56	1.67	-0.10	1.39	14.84	1.77		14.58
79	1.35	1.68	-1.07	-6.57	13.93	-1.19		18.49
80	1.13	1.68	-0.88	-14.65	13.42	-12.36		32.40
81	0.91	1.68	2.34	-24.77	13.23	-27.77		58.83
82	0.69	1.68	8.25	-36.87	12.55	-35.72		77.95
83	0.47	1.68	12.12	-42.32	12.23	-38.30		85.85
84	0.25	1.68	12.01	-38.35	13.35	-38.19		83.54
85	2.63	1.86	11.42	-30.68	16.22	-33.98		73.90
86	2.40	1.86	12.13	-25.57	20.02	-26.16		61.92
87	2.19	1.86	13.31	-25.01	24.54	-16.36		53.17
88	1.98	1.86	9.05	-26.59	32.35	-5.89		52.42
89	1.76	1.86	-0.99	2.88	16.86	1.76		16.55
90	1.55	1.86	-2.20	-12.43	13.94	0.85		23.08
91	1.33	1.86	0.77	-24.87	12.82	-10.59		38.05
92	1.11	1.86	-1.11	-31.81	11.84	-24.32		57.30
93	0.90	1.86	4.32	-37.62	13.65	-29.02		69.02
94	0.68	1.86	10.99	-40.27	15.86	-35.53		81.78
95	0.47	1.86	13.71	-31.05	20.43	-37.36		80.86
96	0.28	1.86	17.10	-18.79	27.32	-31.19		68.40
97	2.63	2.04	21.83	-12.01	34.47	-21.75		56.14
98	2.41	2.04	24.05	-12.29	41.25	-11.63		51.46
99	2.19	2.04	15.51	-17.52	52.19	-2.74		60.58
100	1.98	2.04	-1.41	4.18	18.20	0.77		17.55

## RUN 4

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				
	R	Z	RR	ZZ	TT	RZ	MISES
101	1.76	2.04	-4.88	-13.39	14.16	1.34	24.54
102	1.55	2.04	-5.44	-43.49	7.00	-4.96	46.36
103	1.33	2.04	-8.61	-32.61	11.17	-22.86	54.86
104	1.11	2.04	-2.65	-39.03	14.77	-18.92	57.75
105	0.90	2.04	4.15	-42.11	18.10	-30.91	76.45
106	0.68	2.04	10.18	-22.90	28.94	-31.42	70.91
107	0.47	2.04	25.93	-6.24	43.67	-20.27	56.15
108	0.25	2.04	40.77	-0.52	54.80	-13.68	55.16
109	2.63	2.22	41.52	-2.58	61.33	-7.43	58.11
110	2.41	2.22	25.06	-12.58	72.27	-1.39	73.68
111	2.19	2.22	6.91	31.82	36.11	-17.40	40.67
112	1.98	2.22	-8.75	-36.35	14.58	-18.61	54.65
113	1.76	2.22	-14.67	-44.94	13.31	-12.40	54.84
114	1.55	2.22	-15.44	-53.42	13.54	-28.90	76.73
115	1.33	2.22	2.26	-15.08	37.23	-18.41	56.10
116	1.11	2.22	43.83	4.94	63.88	-2.53	52.09
117	0.90	2.22	59.22	-1.01	71.56	-4.08	67.63
118	0.68	2.22	74.51	12.07	83.62	-11.17	70.21
119	0.47	2.22	29.98	-14.05	80.98	-5.30	82.88
120	0.25	2.23	-5.26	19.95	26.44	-6.87	31.35
121	2.63	2.40	-4.39	-0.18	25.16	-22.10	47.24
122	2.41	2.40	-15.95	-42.31	13.29	-20.28	59.62
123	2.19	2.40	-31.70	-80.73	1.67	-37.38	96.67
124	2.07	2.40	18.55	-1.57	77.00	-9.69	72.66
125	1.76	2.40	-5.40	5.10	18.82	-3.49	21.88
126	1.55	2.40	-6.66	8.96	21.55	-6.47	26.92
127	1.33	2.40	-11.56	-1.27	20.64	-18.00	42.23
128	1.12	2.40	-10.97	-23.52	18.72	-24.21	56.31
129	0.90	2.40	-12.56	-68.09	8.91	-21.99	78.66
130	0.68	2.41	-2.89	-1.98	14.54	-2.51	17.54
131	0.47	2.41	-2.90	1.82	16.87	-3.94	19.14
132	0.25	2.41	-7.97	0.38	17.15	-8.24	26.36
133	2.15	2.48	-9.13	-5.47	18.41	-15.69	37.54
134	1.94	2.48	-8.27	-22.45	17.30	-19.51	48.57
135	1.73	2.48	-1.21	-41.34	17.03	-11.47	55.40
136	1.52	2.48	-0.89	-3.99	13.00	-1.98	16.04
137	1.39	2.49	-3.32	-3.07	14.13	-4.92	19.31
138	1.14	2.49	-4.63	-3.25	15.84	-9.04	25.26
139	0.88	2.49	-5.32	-8.80	16.62	-13.01	32.82
140	0.67	2.49	-2.90	-18.50	17.32	-13.39	38.80
141	0.52	2.49	-0.61	-27.84	18.03	-6.53	41.53
142	0.25	2.49	-0.21	-7.41	11.49	-2.12	16.93
143	2.27	2.60	-0.36	-5.43	13.35	-5.21	19.09
144	2.05	2.60	-1.11	-6.03	14.61	-8.03	23.29
145	1.84	2.60	-0.54	-9.19	15.81	-10.52	28.56
146	1.62	2.60	-0.32	-14.55	16.51	-9.55	31.61
147	1.48	2.60	0.42	-18.88	17.96	-4.03	32.67
148	0.54	2.61	0.29	-10.03	10.39	-0.97	17.76
149	0.32	2.61	2.66	-8.10	12.76	-2.83	18.72
150	2.45	2.78	8.22	-7.88	15.45	-6.64	23.68

ELEM NO.	COORDINATES			STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ		
151	2.25	2.78	2.31	-9.55	14.28	-10.71		27.76
152	2.06	2.78	1.79	-9.97	15.88	-7.51		25.92
153	1.87	2.78	0.78	-12.71	16.97	-3.03		26.27
154	1.67	2.78	-3.41	5.57	12.53	-6.92		18.31
155	1.48	2.78	2.88	1.28	15.26	-12.26		25.03
156	2.63	2.96	1.75	-6.45	14.14	-7.17		21.83
157	2.43	2.96	0.85	-7.26	15.66	-2.78		20.69
158	2.24	2.96	-3.84	-5.51	5.41	-5.14		13.53
159	2.05	2.96	-4.77	-1.42	7.59	-3.11		12.31
160	1.86	2.96	-2.06	1.11	10.86	-6.89		16.69
161	1.67	2.96	0.77	-1.61	12.54	-5.91		16.65
162	1.48	2.96	0.57	-2.56	14.04	-2.32		15.79
163	2.63	3.14	-1.13	-4.00	4.61	-2.85		9.05
164	2.43	3.14	-2.05	-3.79	5.13	-3.16		9.84
165	2.24	3.14	-1.90	-1.51	6.71	-2.77		9.69
166	2.05	3.14	-1.58	0.30	8.52	-3.48		11.08
167	1.86	3.14	-0.12	0.44	10.40	-3.31		11.75
168	1.67	3.14	0.37	0.99	12.35	-1.45		11.95
169	1.48	3.14	-0.40	-4.67	3.75	-1.96		8.04
170	2.63	3.32	-0.27	-3.43	4.60	-2.86		8.58
171	2.43	3.32	-0.54	-1.11	5.84	-2.38		7.86
172	2.24	3.32	-0.35	0.60	7.28	-1.90		7.92
173	2.05	3.32	0.30	1.44	8.81	-1.44		8.39
174	1.86	3.32	0.35	2.78	10.60	-0.57		9.33
175	1.67	3.32	0.26	-6.99	2.45	-1.50		8.94
176	1.48	3.32	0.80	-3.25	4.01	-2.66		7.81
177	2.63	3.50	0.47	-0.15	5.30	-2.08		6.30
178	2.43	3.50	0.89	1.40	6.56	-0.72		5.57
179	2.24	3.50	1.06	1.92	7.56	-0.48		6.18
180	2.07	3.50	0.46	3.42	8.93	-0.18		7.45
181	1.86	3.50	0.39	-8.53	1.55	-0.60		9.60
182	1.67	3.50	2.07	-3.92	3.59	-1.41		7.29
183	1.48	3.50	4.46	1.54	6.09	-2.31		5.65
184	2.25	3.69	2.32	2.03	6.00	-0.17		3.85
185	2.06	3.69	1.26	1.91	6.19	-0.54		4.73
186	1.86	3.69	0.47	3.79	7.40	-0.20		6.01
187	1.67	3.69	-1.74	-2.99	1.49	-3.01		6.57
188	1.48	3.69	0.78	0.11	3.67	-0.94		3.66
189	2.44	3.87	0.77	2.54	4.90	-0.69		3.78
190	2.25	3.87	0.32	4.19	5.99	-0.24		5.03
191	2.05	3.87	-1.19	-2.11	0.75	-1.78		3.99
192	1.86	3.87	-0.84	-1.24	1.42	-0.79		2.83
193	1.67	3.87	-0.24	0.69	2.47	-0.09		2.39
194	1.48	3.87	0.14	2.68	3.61	-0.07		3.11
195	2.63	4.06	0.17	4.50	4.76	-0.05		4.46
196	2.43	4.06	-0.33	-1.29	0.61	-0.94		2.31
197	2.24	4.06	-0.50	-1.24	0.74	-0.88		2.31
198	2.05	4.06	-0.13	-0.39	1.24	-0.27		1.59
199	1.86	4.06	0.00	1.04	1.90	0.33		1.75
200	1.67	4.06	0.12	2.63	2.72	0.45		2.67

## RUN 4

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ	
201	1.48	4.06	0.11	4.33	3.68	0.24	3.96
202	2.63	4.24	-0.09	-1.44	0.33	-0.60	1.91
203	2.43	4.24	0.08	-0.82	0.61	-0.68	1.72
204	2.24	4.24	0.09	0.26	1.02	-0.08	0.87
205	2.05	4.24	0.16	1.40	1.52	0.58	1.65
206	1.86	4.24	0.25	2.51	2.09	0.74	2.45
207	1.67	4.24	0.14	3.81	2.78	0.39	3.35
208	1.49	4.24	0.12	-2.08	-0.09	-0.44	2.24
209	2.63	4.42	0.32	-0.49	0.44	-0.64	1.42
210	2.43	4.42	0.16	1.00	0.89	-0.06	0.80
211	2.24	4.42	0.33	1.80	1.30	0.90	2.03
212	2.05	4.42	0.46	2.25	1.61	0.85	2.16
213	1.86	4.42	0.15	3.15	2.00	0.36	2.70
214	1.67	4.42	0.14	-2.50	-0.38	-0.17	2.44
215	1.48	4.42	0.65	-0.54	0.32	-0.36	1.23
216	2.63	4.60	1.16	2.09	1.23	-0.38	1.11
217	2.43	4.60	0.83	2.15	1.24	1.30	2.53
218	2.24	4.60	0.36	1.65	0.98	0.60	1.53
219	2.05	4.60	0.12	2.64	1.34	0.25	2.22
220	1.86	4.60	-0.59	-2.61	-1.00	-0.76	2.26
221	1.67	4.60	-0.08	-0.49	-0.22	1.06	1.87
222	1.48	4.60	0.10	1.56	0.50	0.50	1.57
223	2.25	4.79	0.03	2.21	0.75	0.20	1.95
224	2.06	4.79	-0.24	-0.47	-0.44	-0.36	0.66
225	1.86	4.79	0.07	-0.64	-0.39	-0.13	0.66
226	1.67	4.79	0.0	-0.15	-0.35	0.80	1.41
227	1.48	4.79	-0.14	1.01	-0.04	0.70	1.65
228	2.44	4.97	-0.02	1.80	0.26	0.27	1.76
229	2.25	4.97	-0.07	-0.26	-0.45	-0.22	0.51
230	2.05	4.97	-0.11	-0.26	-0.47	-0.19	0.46
231	1.86	4.97	0.03	-0.15	-0.45	0.09	0.44
232	1.67	4.97	0.05	0.20	-0.39	0.57	1.12
233	1.48	4.97	-0.04	0.75	-0.30	0.68	1.50
234	2.63	5.16	-0.03	1.25	-0.18	0.34	1.48
235	2.43	5.16	-0.02	-0.34	-0.56	-0.18	0.57
236	2.24	5.16	0.01	-0.09	-0.53	-0.20	0.61
237	2.05	5.16	-0.01	0.22	-0.50	0.10	0.66
238	1.67	5.16	0.01	0.60	-0.51	0.61	1.42
239	1.86	5.16	0.0	0.45	-0.49	0.50	1.19
240	1.48	5.16	0.0	0.70	-0.56	0.31	1.22
241	2.63	5.34	0.05	-0.57	-0.71	-0.17	0.76
242	2.43	5.34	0.15	0.04	-0.58	-0.27	0.82
243	2.24	5.34	0.04	0.61	-0.51	-0.02	0.97
244	2.05	5.34	0.06	0.68	-0.54	-0.54	1.41
245	1.86	5.34	0.15	0.42	-0.69	0.52	1.35
246	1.67	5.34	0.01	0.25	-0.92	0.19	1.12
247	1.48	5.34	0.08	-0.75	-0.82	-0.07	0.88
248	2.63	5.52	0.36	-0.02	-0.61	-0.17	0.90
249	2.43	5.52	0.72	1.12	-0.28	-0.27	1.34
250	2.24	5.52	0.57	0.95	-0.47	0.63	1.68

## RUN 4

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES			STRESSES(KPSI)			RZ	MISES
	R	Z	RR	ZZ	TT			
251	2.05	5.52	0.06	0.02	-1.07	0.18	1.15	
252	1.86	5.52	-0.04	0.04	-1.26	0.03	1.27	

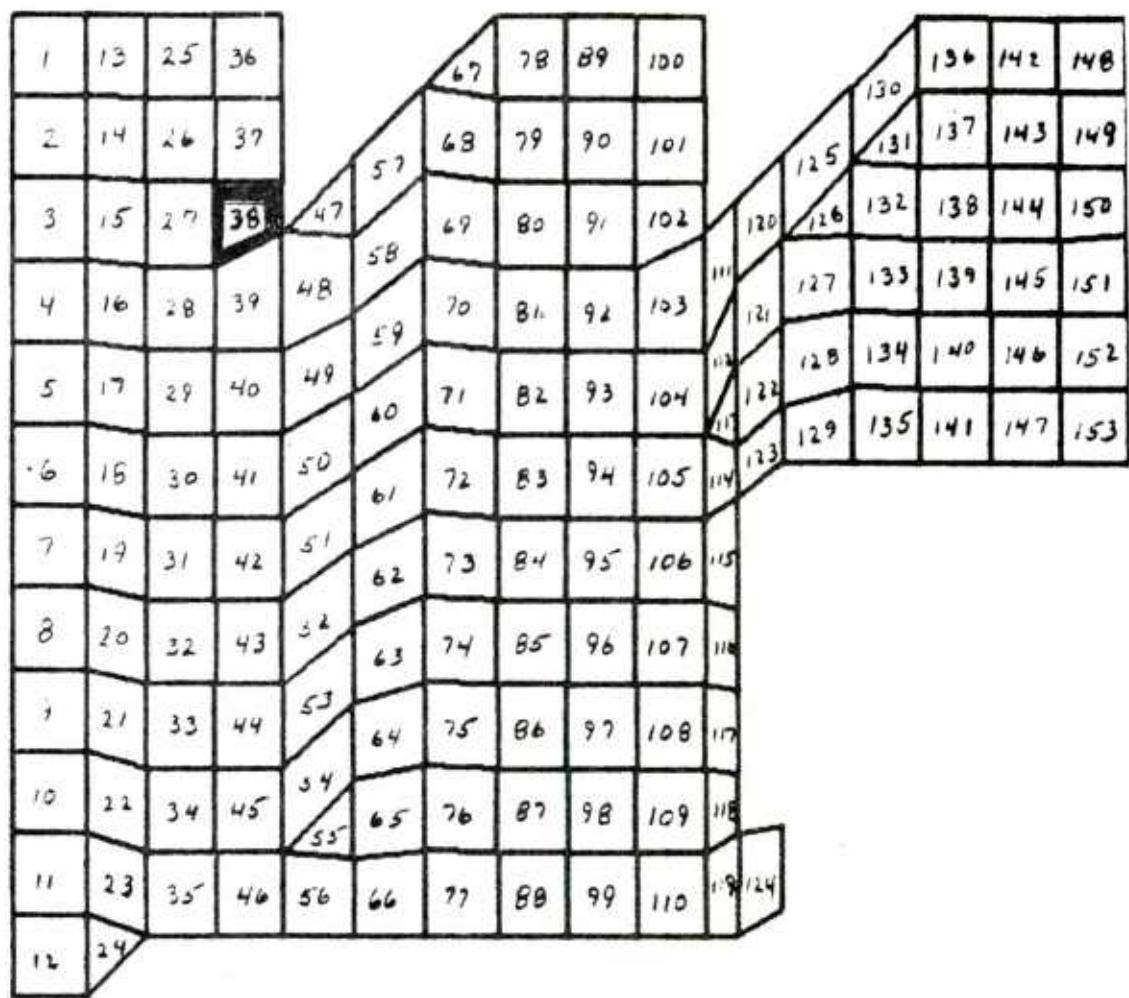


Figure 10. Geometry plot - Run 4.

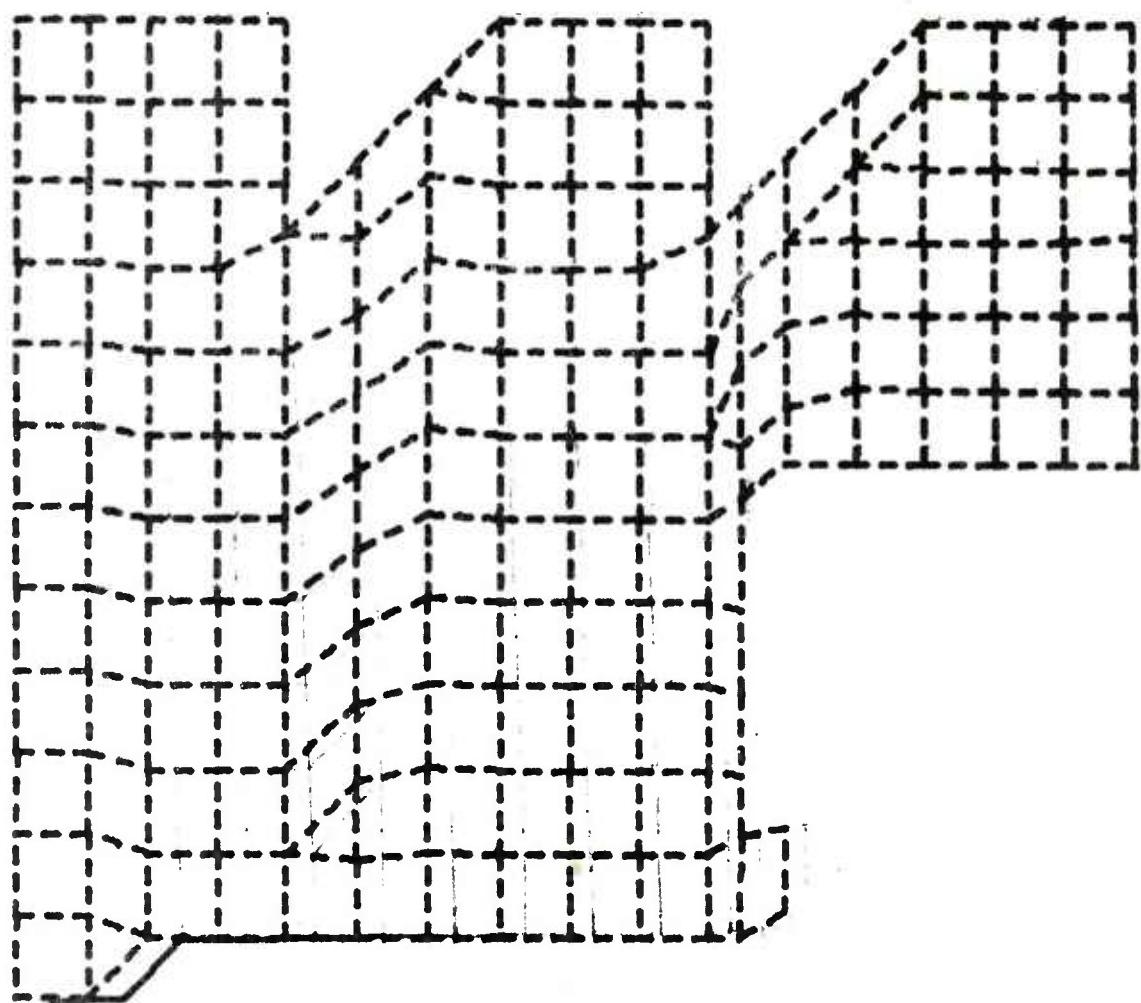


Figure 11. Distortion plot - Run 4.

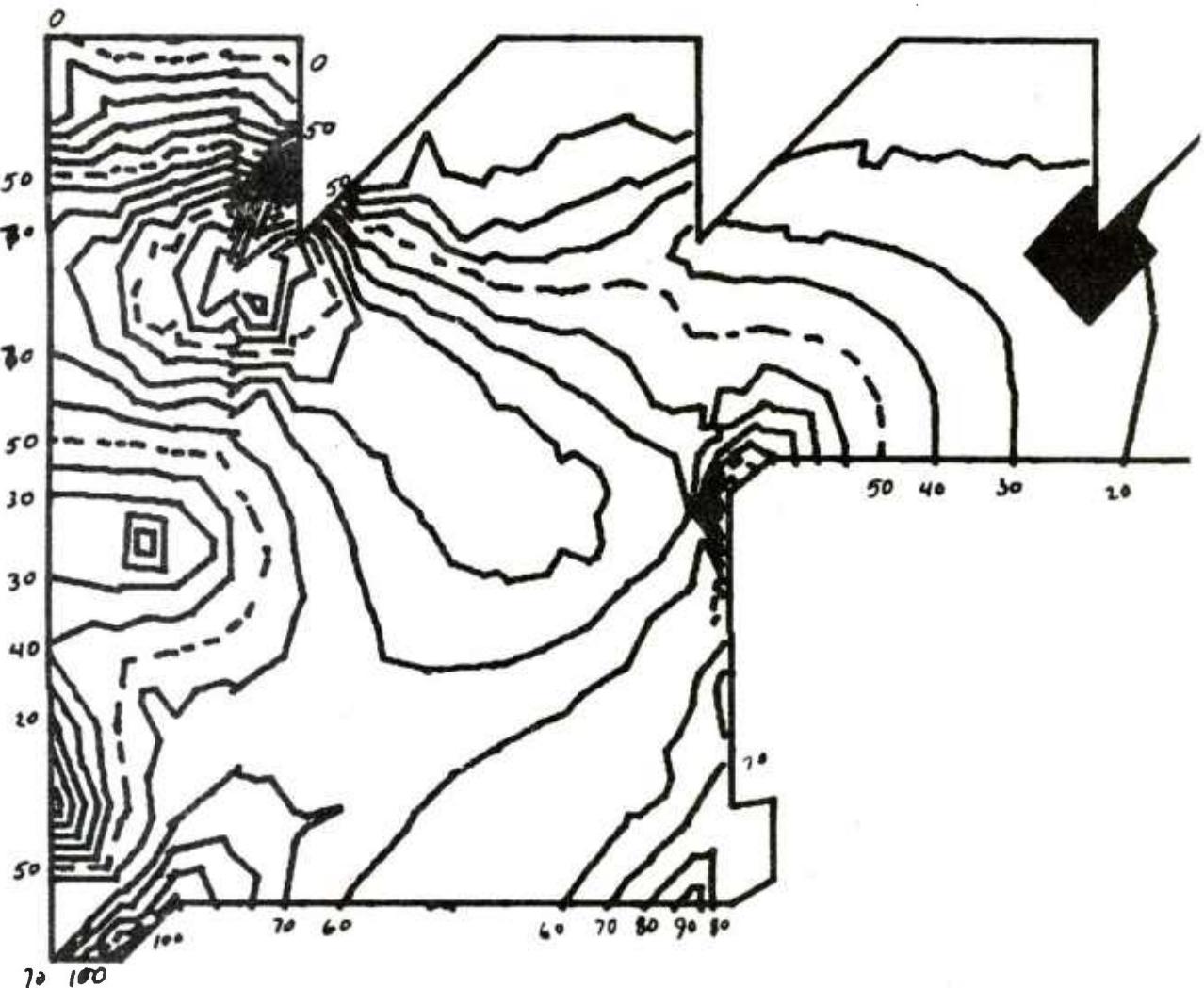


Figure 12. Stress plot - Run 4.

## RUN 5

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				
	R	Z	RR	ZZ	TT	RZ	MISES
1	2.62	0.60	3.76	3.72	-4.59	6.82	14.45
2	2.41	0.60	6.51	-29.09	-14.74	-6.63	33.07
3	2.20	0.60	-6.77	-91.00	-40.82	-16.14	78.54
4	1.99	0.60	-25.14	-119.59	-60.53	-8.36	83.91
5	1.78	0.60	-38.42	-117.27	-68.75	-7.87	70.22
6	1.57	0.61	-38.53	-90.54	-66.62	9.02	47.72
7	1.36	0.61	-25.97	-80.32	-50.20	10.29	28.60
8	1.15	0.61	-32.91	-24.98	-53.78	-22.42	46.60
9	0.94	0.61	-66.83	-85.01	-88.10	-26.89	50.65
10	0.72	0.61	-94.32	-116.64	-115.85	-9.11	27.02
11	0.51	0.61	-104.73	-116.79	-130.97	-8.23	26.85
12	0.30	0.61	-84.53	-102.20	-160.44	-17.33	75.07
13	0.09	0.61	-1.62	5.65	3.51	5.50	11.52
14	2.62	0.79	0.09	-43.88	-10.98	-5.35	40.68
15	2.41	0.79	4.57	-94.35	-27.71	-22.72	95.82
16	2.20	0.79	-3.44	-114.84	-41.77	-26.57	108.29
17	1.99	0.79	-16.16	-105.76	-48.48	-14.78	82.66
18	1.78	0.79	-23.74	-77.30	-47.58	1.51	46.55
19	1.57	0.79	-39.74	-44.19	-45.65	-4.00	8.74
20	1.36	0.80	-51.08	-44.81	-48.61	-31.21	54.33
21	1.15	0.80	-52.62	-76.30	-58.35	-39.76	72.12
22	0.94	0.80	-59.81	-102.64	-72.47	-26.79	60.04
23	0.73	0.80	-61.73	-110.47	-86.14	-25.45	61.03
24	0.51	0.80	-72.31	-129.45	-125.80	-36.77	84.42
25	0.30	0.80	-1.38	7.91	10.87	3.70	12.79
26	0.09	0.80	-0.57	-57.87	-8.14	0.80	53.93
27	2.63	0.95	12.31	-106.90	-22.14	-24.32	114.30
28	2.41	0.95	-2.98	-109.64	-33.08	-43.12	121.08
29	2.19	0.95	-12.85	-87.23	-32.99	-21.60	76.42
30	1.98	0.95	-17.94	-72.47	-33.48	-9.30	51.25
31	1.76	0.95	-30.30	-56.79	-34.58	-18.17	39.97
32	1.54	0.95	-38.89	-52.34	-35.45	-36.12	64.43
33	1.33	0.95	-41.59	-66.43	-39.18	-40.44	74.77
34	1.11	0.95	-42.42	-87.11	-45.98	-30.88	68.63
35	0.90	0.95	-33.80	-117.78	-58.71	-23.81	85.33
36	0.68	0.95	-1.79	10.23	15.23	1.49	15.38
37	0.47	0.96	-5.91	-57.96	-5.36	3.20	52.61
38	0.25	0.96	-3.18	-153.91	-34.56	-12.14	139.35
39	2.63	1.12	-14.54	-100.00	-26.64	-58.44	129.08
40	2.41	1.12	-2.61	-65.89	-13.59	-20.56	68.54
41	2.19	1.12	-9.06	-73.07	-20.17	-18.09	67.02
42	1.99	1.12	-14.76	-64.89	-21.33	-26.35	65.65
43	1.76	1.13	-21.09	-53.95	-20.95	-41.97	79.81
44	1.55	1.13	-29.81	-53.37	-21.54	-40.52	75.79
45	1.33	1.13	-26.34	-69.50	-22.09	-27.79	66.20
46	1.11	1.13	-11.99	-90.77	-26.80	-12.71	75.78
47	0.96	1.13	19.13	95.46	48.61	6.58	67.64
48	0.68	1.13	14.02	15.74	26.18	-57.03	99.43
49	0.47	1.13	2.45	-73.52	-5.93	-30.31	89.22
50	0.25	1.13	0.03	-69.09	-6.19	-23.72	77.94

## RUN 5

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ	
51	2.63	1.30	-3.91	-72.44	-9.48	-27.70	81.53
52	2.41	1.30	-3.68	-66.31	-8.98	-41.61	93.88
53	2.19	1.30	-9.35	-32.14	-0.86	-46.95	86.01
54	2.07	1.30	-11.46	-39.27	0.77	-26.34	57.83
55	1.76	1.30	-2.79	-61.40	2.31	-15.63	67.03
56	1.55	1.30	-1.40	-72.26	0.03	-7.45	72.74
57	1.33	1.30	-7.39	7.70	15.37	2.94	20.69
58	1.11	1.31	-2.27	24.98	26.03	-28.09	56.03
59	0.90	1.31	9.63	-25.68	16.76	-43.54	85.06
60	0.68	1.31	3.95	-58.63	5.34	-33.23	85.54
61	0.47	1.31	-1.39	-68.77	1.25	-27.41	83.54
62	0.25	1.31	-4.92	-80.84	-2.76	-28.04	91.06
63	2.25	1.49	12.52	-30.75	13.36	-78.92	143.51
64	2.05	1.49	22.06	3.32	33.92	-23.82	49.16
65	1.85	1.49	15.26	-38.71	22.77	-15.08	63.70
66	1.65	1.49	6.37	-62.01	18.24	-6.08	75.76
67	1.45	1.49	0.25	1.91	16.74	2.66	16.39
68	1.25	1.49	-0.34	2.18	17.82	0.10	17.05
69	1.05	1.49	-9.01	-0.02	17.39	-12.12	31.31
70	0.85	1.49	-1.46	-16.08	18.59	-35.06	67.80
71	0.65	1.49	3.55	-42.24	14.57	-38.07	84.09
72	0.45	1.49	-1.98	-56.05	10.55	-33.23	84.08
73	0.25	1.49	-11.11	-95.47	0.39	-32.61	106.82
74	2.44	1.67	27.09	39.47	47.95	-34.42	62.33
75	2.22	1.67	20.64	-22.81	31.03	-23.39	63.95
76	2.00	1.67	10.72	-46.10	28.82	-9.50	69.68
77	1.78	1.67	-0.34	2.53	18.41	1.98	17.82
78	1.56	1.67	-2.34	-4.99	17.85	-1.33	21.76
79	1.35	1.68	-3.57	-13.46	17.57	-13.17	35.70
80	1.01	1.66	-2.78	-24.84	17.42	-28.72	61.77
81	0.89	1.66	-0.59	-39.27	16.71	-35.76	79.38
82	0.69	1.68	-1.76	-53.29	15.19	-37.25	89.33
83	0.47	1.68	-0.52	-70.36	14.81	-26.64	91.17
84	0.25	1.68	0.92	15.55	22.33	-12.21	28.40
85	2.63	1.86	12.55	-4.97	27.45	-20.51	45.30
86	2.41	1.86	8.65	-28.29	28.28	-10.38	52.89
87	2.19	1.86	-1.25	3.92	20.40	1.67	19.79
88	1.98	1.86	-3.06	-11.36	17.81	0.26	26.04
89	1.76	1.86	-0.90	-24.27	16.96	-12.05	41.45
90	1.55	1.86	-4.32	-31.75	16.33	-26.85	62.51
91	1.33	1.86	-2.37	-38.95	18.19	-31.39	73.96
92	1.01	1.86	1.91	-47.91	20.18	-34.08	84.92
93	0.89	1.86	1.65	-48.09	25.30	-24.16	77.21
94	0.68	1.86	1.03	6.14	12.94	-5.18	13.70
95	0.47	1.86	4.49	-1.44	17.07	-11.22	25.41
96	0.25	1.87	5.52	-12.62	22.14	-7.55	32.83
97	2.63	2.04	-1.51	4.97	21.69	0.67	20.77
98	2.41	2.04	-4.89	-12.85	18.05	0.85	27.83
99	2.19	2.04	-4.92	-43.57	11.31	-6.43	50.09
100	1.98	2.04	-9.24	-33.56	15.49	-25.68	61.51

## RUN 5

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES		STRESSES(KPSI)				
	R	Z	RR	ZZ	TT	RZ	MISES
101	1.76	2.04	-3.07	-37.79	20.71	-23.22	64.92
102	1.55	2.04	1.08	-45.65	23.42	-29.09	79.16
103	1.33	2.04	0.96	-27.80	35.72	-21.70	66.69
104	1.01	2.04	0.15	1.69	6.77	-1.83	6.80
105	0.89	2.05	2.34	-0.24	10.00	-4.97	12.61
106	0.68	2.05	2.94	-4.13	14.21	-3.63	17.21
107	0.47	2.05	7.81	33.99	41.21	-19.88	45.96
108	0.25	2.05	-7.24	-37.59	19.40	-21.03	61.37
109	2.63	2.22	-6.79	-43.15	21.09	-18.29	64.16
110	2.41	2.22	-5.55	-46.05	24.40	-26.08	76.09
111	2.19	2.22	-2.73	-13.34	45.33	-16.99	61.64
112	1.98	2.22	0.15	0.40	3.97	-0.51	3.81
113	1.76	2.22	1.20	-0.16	5.93	-2.09	6.62
114	1.55	2.22	1.78	-0.98	9.43	-1.52	9.71
115	1.33	2.22	-6.06	20.68	29.90	-8.01	35.20
116	1.01	2.22	-3.94	0.74	29.66	-23.76	51.84
117	0.89	2.23	-13.65	-43.38	18.35	-19.53	63.28
118	0.68	2.23	-17.50	-49.89	20.78	-23.35	73.41
119	0.47	2.23	-14.74	-9.58	47.51	-11.15	62.88
120	0.25	2.23	-0.18	-0.13	2.17	-0.04	2.33
121	2.63	2.40	0.23	0.24	3.46	-0.64	3.42
122	2.41	2.40	0.75	-0.39	5.47	-0.43	5.43
123	2.20	2.40	-6.25	4.81	21.26	-4.25	25.08
124	2.07	2.40	-7.51	9.51	24.47	-7.25	30.42
125	1.76	2.40	-12.76	-0.74	23.95	-19.00	46.19
126	1.55	2.40	-12.65	-21.95	22.93	-25.23	59.95
127	1.33	2.40	-21.98	-75.44	9.50	-28.58	89.35
128	1.01	2.40	-3.40	-2.68	16.37	-3.10	20.15
129	0.89	2.41	-3.28	1.55	18.99	-4.69	21.86
130	0.68	2.41	-8.90	0.40	19.51	-8.98	29.52
131	0.47	2.41	-10.38	-4.91	21.30	-16.82	41.34
132	0.25	2.41	-10.40	-23.03	20.23	-21.54	53.76
133	2.15	2.48	-1.47	-44.03	20.59	-13.42	61.45
134	1.94	2.48	-1.01	-4.96	14.53	-2.42	18.33
135	1.73	2.48	-3.67	-3.63	15.90	-5.66	21.88
136	1.52	2.48	-5.17	-3.21	18.01	-9.92	28.13
137	1.31	2.48	-6.14	-8.75	19.07	-14.12	36.15
138	1.01	2.48	-3.42	-18.99	20.16	-14.69	42.57
139	0.89	2.49	-0.82	-28.91	21.29	-7.29	45.37
140	0.67	2.49	-0.19	-8.99	12.68	-2.52	19.38
141	0.46	2.49	-0.29	-6.07	14.98	-5.99	21.50
142	0.25	2.49	-1.24	-6.03	16.58	-8.88	25.74
143	2.27	2.60	-0.57	-9.10	18.12	-11.28	31.03
144	2.05	2.60	-0.27	-14.80	19.06	-10.30	34.41
145	1.84	2.60	0.51	-19.11	20.92	-4.36	35.48
146	1.62	2.60	0.38	-12.04	11.35	-1.14	20.37
147	1.48	2.60	3.19	-9.05	14.27	-3.27	20.98
148	1.01	2.60	9.53	-7.64	17.65	-7.50	25.86
149	0.89	2.61	2.87	-9.39	16.40	-11.31	29.72
150	0.75	2.61	2.11	-9.99	18.11	-8.08	28.14

## RUN 5

CHAMBER PRESSURE=117839

ELEM NO.	COORDINATES			STRESSES(KPSI)			
	R	Z	RR	ZZ	TT	RZ	MISES
151	.54	2.61	.92	-12.46	19.54	-3.26	28.40
152	.82	2.61	-3.98	5.19	13.50	-7.96	20.48
153	2.45	2.78	3.16	1.41	16.86	-13.10	27.00
154	2.25	2.78	2.00	-6.13	15.99	-7.72	23.55
155	2.06	2.78	.97	-6.60	17.84	-2.98	22.28
156	1.87	2.78	-4.31	-6.28	5.85	-5.81	15.11
157	1.67	2.78	-5.21	-1.77	8.29	-3.45	13.54
158	1.48	2.78	-2.22	1.36	11.98	-7.27	17.94
159	2.63	2.96	.84	-1.02	14.01	-6.24	17.84
160	2.43	2.96	.64	-1.57	15.85	-2.46	16.97
161	2.24	2.96	-1.26	-4.50	4.97	-3.21	10.02
162	2.06	2.96	-2.26	-4.27	5.54	-3.52	10.85
163	1.86	2.96	-2.02	-1.67	7.32	-2.98	10.52
164	1.67	2.96	-1.65	.59	9.39	-3.59	11.86
165	1.48	2.96	-0.09	1.13	11.55	-3.39	12.54
166	2.63	3.14	.42	2.13	13.84	-1.48	12.91
167	2.43	3.14	-0.44	-5.24	4.01	-2.19	8.87
168	2.24	3.14	-0.25	-3.80	4.97	-3.16	9.40
169	2.05	3.14	-0.54	-1.11	6.36	-2.53	8.43
170	1.86	3.14	-0.32	.98	8.00	-1.88	8.40
171	1.67	3.14	.38	2.15	9.74	-1.36	8.94
172	1.48	3.14	.41	3.91	11.80	-0.52	10.15
173	2.63	3.32	.30	-7.81	2.55	-1.67	9.88
174	2.43	3.32	.92	-3.54	4.31	-2.94	8.50
175	2.24	3.32	.54	.06	5.76	-2.20	6.67
176	2.05	3.32	1.02	1.90	7.18	-0.58	5.86
177	1.86	3.32	1.22	2.61	8.33	-0.33	6.55
178	1.67	3.32	.52	4.44	9.87	-0.11	8.14
179	1.48	3.32	.44	-9.52	1.54	-0.66	10.61
180	2.63	3.50	2.31	-4.24	3.84	-1.56	7.91
181	2.43	3.50	4.93	2.05	6.65	-2.50	5.92
182	2.24	3.50	2.61	2.64	6.59	-0.08	3.95
183	2.07	3.50	1.41	2.48	6.76	-0.44	4.96
184	1.86	3.50	.53	4.73	8.13	-0.15	6.60
185	1.67	3.50	-1.93	-3.60	1.40	-3.30	7.22
186	1.48	3.50	.82	.11	3.85	-0.77	3.70
187	2.25	3.69	.85	3.12	5.31	-0.62	4.01
188	2.06	3.69	.35	5.05	6.53	-0.22	5.60
189	1.87	3.69	-1.28	-2.30	.73	-1.93	4.28
190	1.67	3.69	-0.85	-1.39	1.44	-0.83	2.98
191	1.48	3.69	-0.23	.78	2.57	-0.07	2.46
192	2.44	3.87	.14	3.16	3.85	-0.07	3.42
193	2.25	3.87	.19	5.29	5.14	-0.0	5.03
194	2.05	3.87	-0.35	-1.40	.59	-1.01	2.45
195	1.86	3.87	-0.52	-1.34	.72	-0.94	2.42
196	1.67	3.87	-0.10	-0.41	1.26	-0.24	1.59
197	1.48	3.87	.04	1.20	1.98	-0.47	1.88
198	2.63	4.06	.14	3.04	2.87	-0.60	3.01
199	2.43	4.06	.12	5.01	3.94	-0.31	4.49
200	2.24	4.06	-0.09	-1.55	.28	-0.64	2.01

CHAMBER PRESSURE=117839

RUN 5

ELEM NO.	COORDINATES			STRESSES(KPSI)				MISES
	R	Z	RR	ZZ	TT	RZ		
201	2.05	4.00	0.10	-0.86	0.58	-0.72	1.78	
202	1.86	4.06	0.12	0.33	1.02	-0.03	0.82	
203	1.67	4.06	0.20	1.62	1.57	0.71	1.87	
204	1.48	4.06	0.28	2.89	2.19	0.89	2.80	
205	2.63	4.24	0.15	4.37	2.94	0.47	3.80	
206	2.43	4.24	0.13	-2.23	-0.17	-0.47	2.37	
207	2.24	4.24	0.36	-0.49	0.40	-0.68	1.46	
208	2.05	4.24	0.17	1.15	0.89	-0.02	0.88	
209	1.86	4.24	0.36	2.06	1.33	1.06	2.35	
210	1.67	4.24	0.51	2.58	1.66	1.00	2.49	
211	1.48	4.24	0.16	3.59	2.09	0.42	3.06	
212	2.63	4.42	0.15	-2.67	-0.48	-0.18	2.59	
213	2.43	4.42	0.70	-0.53	0.27	-0.38	1.26	
214	2.24	4.42	1.23	2.37	1.26	-0.38	1.31	
215	2.05	4.42	0.90	2.44	1.28	1.49	2.94	
216	1.86	4.42	0.38	1.88	0.97	0.71	1.79	
217	1.67	4.42	0.13	2.99	1.37	0.29	2.54	
218	1.48	4.42	-0.64	-2.91	-1.19	-0.79	2.48	
219	2.63	4.60	-0.11	-0.54	-0.35	1.24	2.18	
220	2.43	4.60	0.09	1.76	0.46	0.59	1.83	
221	2.24	4.60	0.03	2.43	0.73	0.24	2.23	
222	2.07	4.60	-0.24	-0.49	-0.53	-0.37	0.69	
223	1.86	4.60	0.10	-0.70	-0.49	-0.13	0.75	
224	1.67	4.60	0.01	-0.17	-0.45	0.92	1.64	
225	1.48	4.60	-0.16	1.13	-0.13	0.81	1.90	
226	2.25	4.79	-0.02	2.01	0.19	0.31	2.00	
227	2.06	4.79	-0.07	-0.26	-0.53	-0.23	0.56	
228	1.86	4.79	-0.11	-0.27	-0.56	-0.19	0.52	
229	1.67	4.79	0.04	-0.16	-0.54	0.11	0.55	
230	1.18	4.79	0.07	0.22	-0.49	0.64	1.29	
231	2.44	4.97	-0.04	0.83	-0.41	0.76	1.71	
232	2.25	4.97	-0.04	1.38	-0.28	0.38	1.69	
233	2.05	4.97	-0.02	-0.35	-0.64	-0.19	0.63	
234	1.86	4.97	0.01	-0.08	-0.62	-0.20	0.69	
235	1.67	4.97	0.00	0.25	-0.59	0.12	0.78	
236	1.48	4.97	0.01	0.49	-0.59	0.56	1.35	
237	2.63	5.16	0.01	0.66	-0.62	0.67	1.61	
238	2.43	5.16	0.00	0.77	-0.69	0.35	1.40	
239	2.24	5.16	0.06	-0.59	-0.81	-0.18	0.84	
240	2.05	5.16	0.16	0.07	-0.67	-0.28	0.92	
241	1.86	5.16	0.04	0.67	-0.60	-0.01	1.10	
242	1.67	5.16	0.06	0.74	-0.64	0.60	1.58	
243	1.48	5.16	0.16	0.46	-0.82	0.57	1.51	
244	2.63	5.34	0.01	0.27	-1.07	0.21	1.28	
245	2.43	5.34	0.09	-0.78	-0.92	-0.08	0.96	
246	2.24	5.34	0.39	0.0	-0.70	-0.18	1.01	
247	2.05	5.34	0.77	1.22	-0.36	-0.29	1.50	
248	1.86	5.34	0.61	1.03	-0.57	0.69	1.86	
249	1.67	5.34	0.06	0.02	-1.22	0.19	1.31	
250	1.48	5.34	-0.05	0.04	-1.44	0.03	1.44	

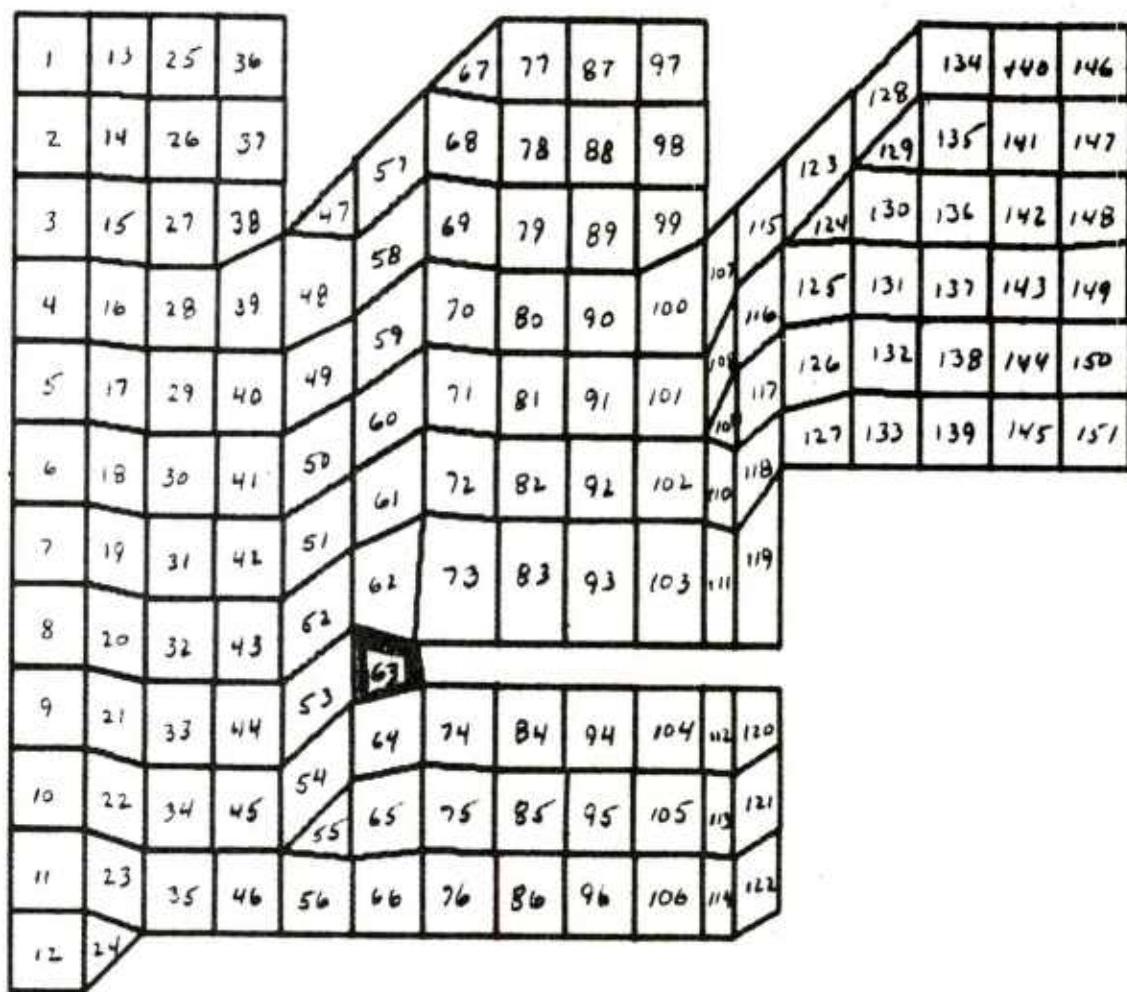


Figure 13. Geometry plot - Run 5.

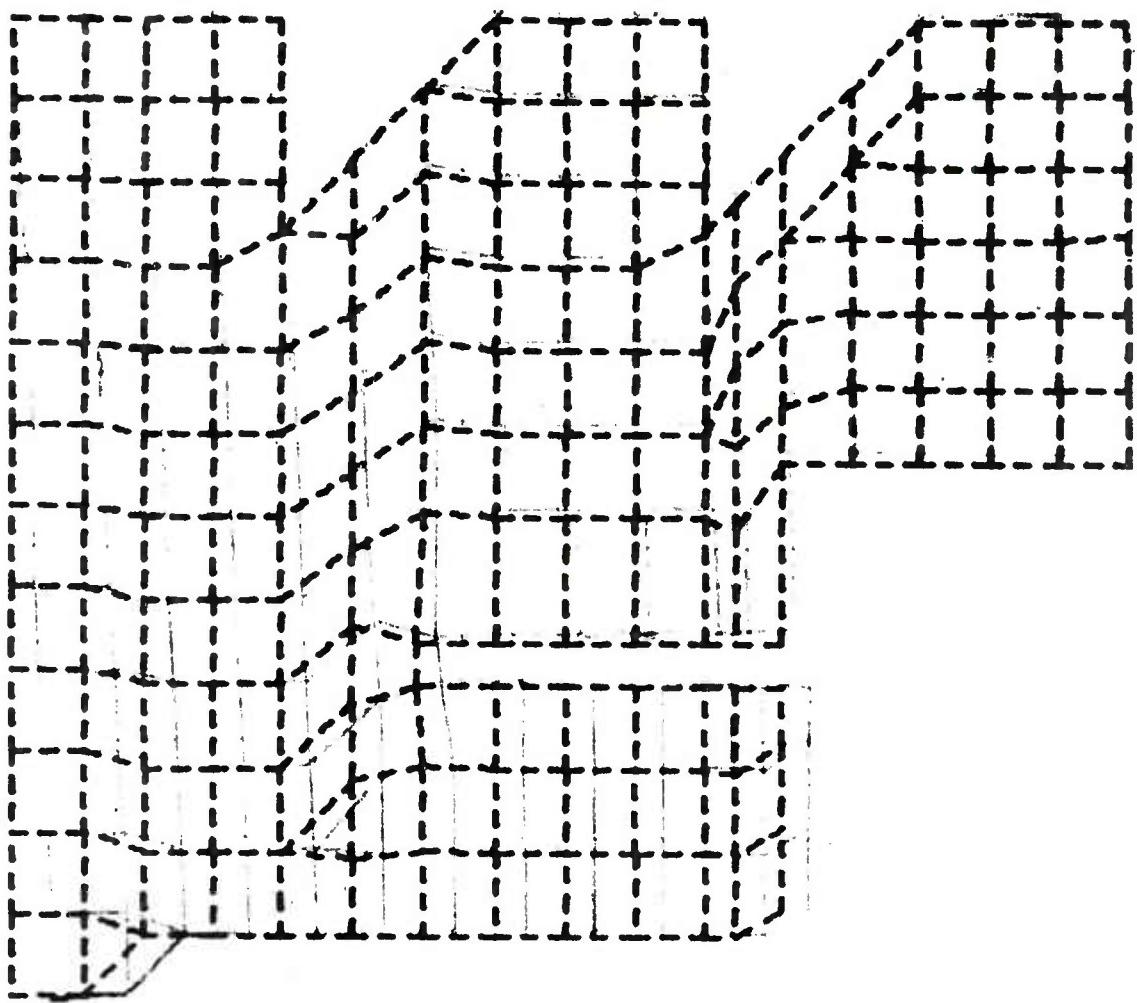


Figure 14. Distortion Plot - Run 5.

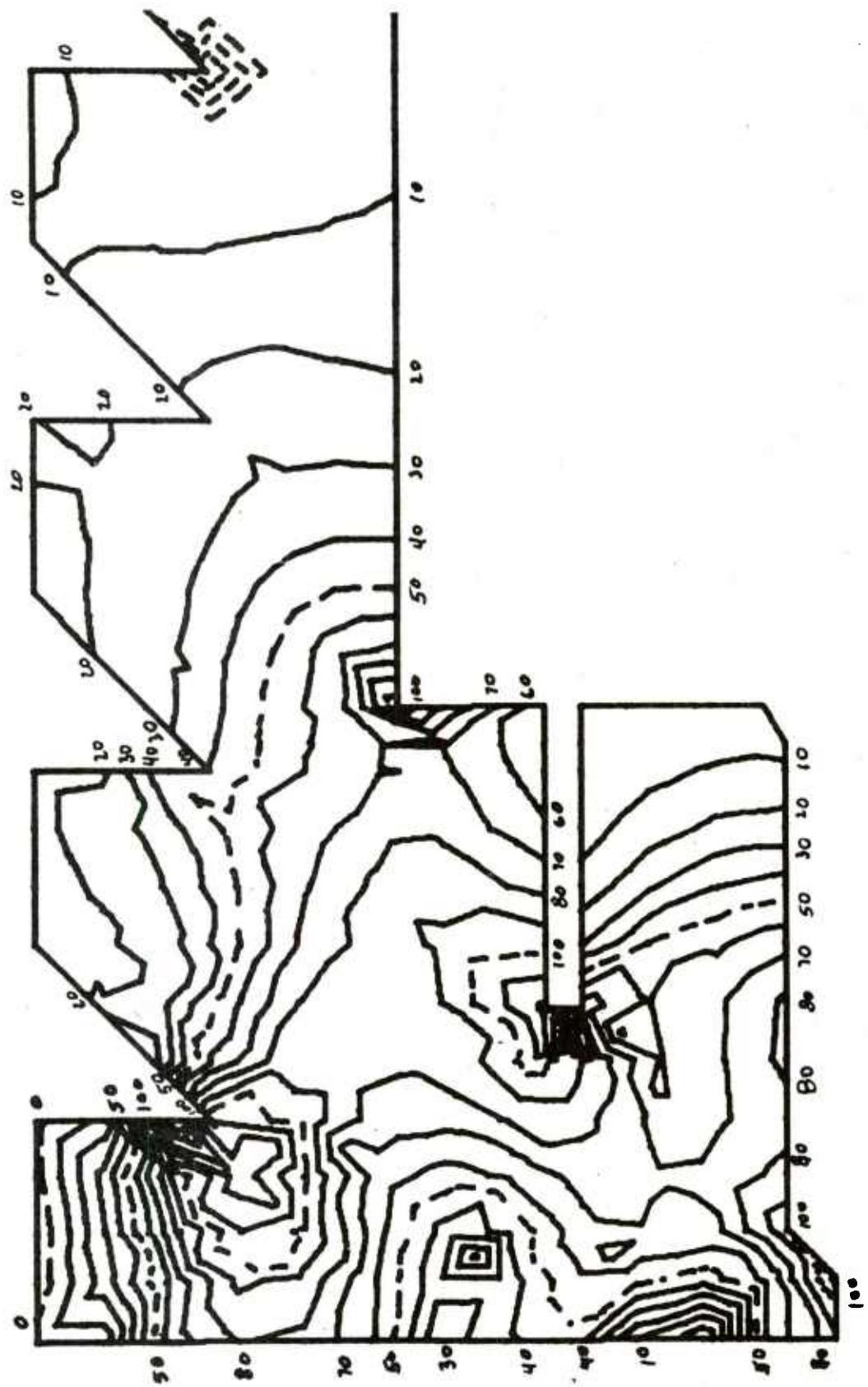


Figure 15. Stress plot - Run 5.

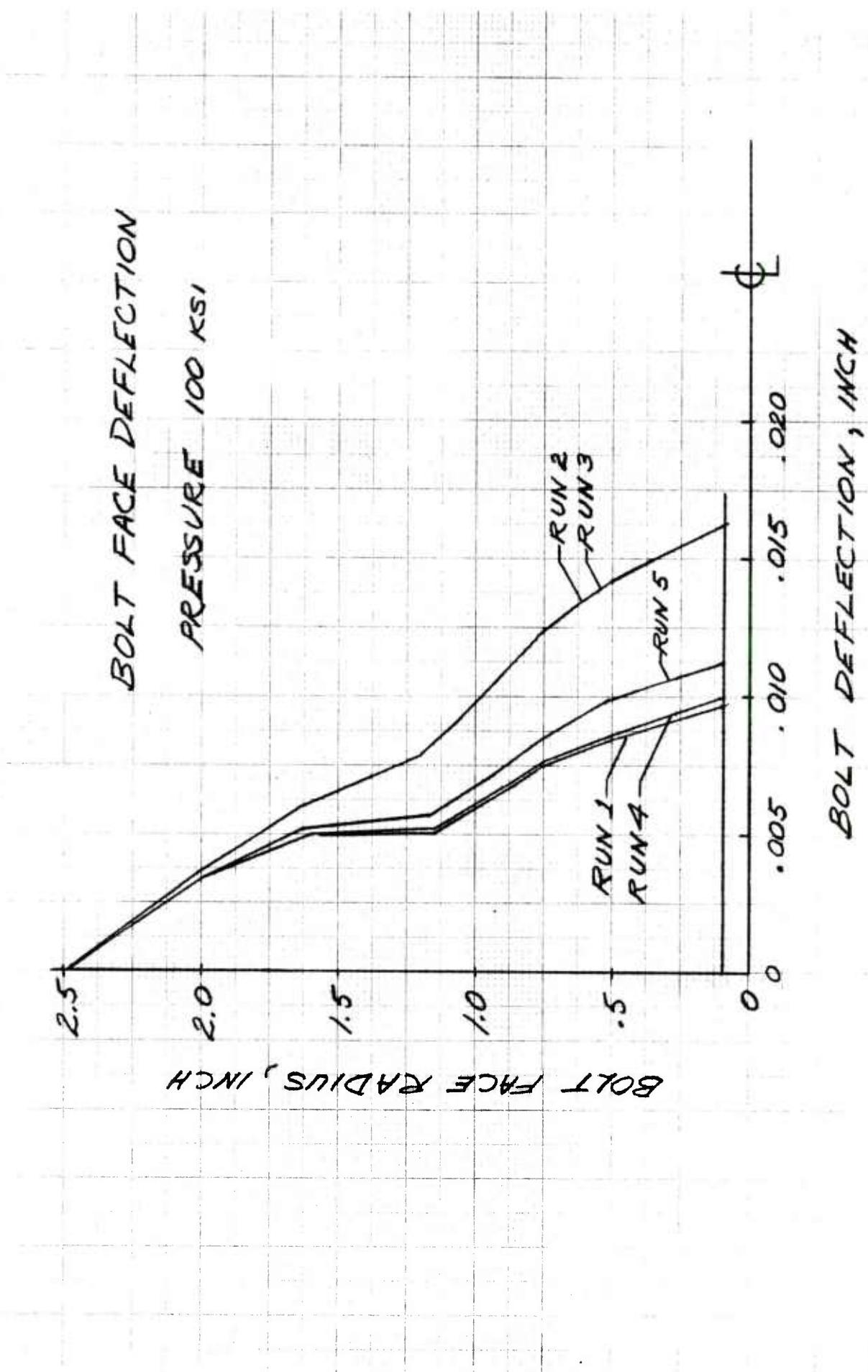


Figure 16. Bolt face deflection.

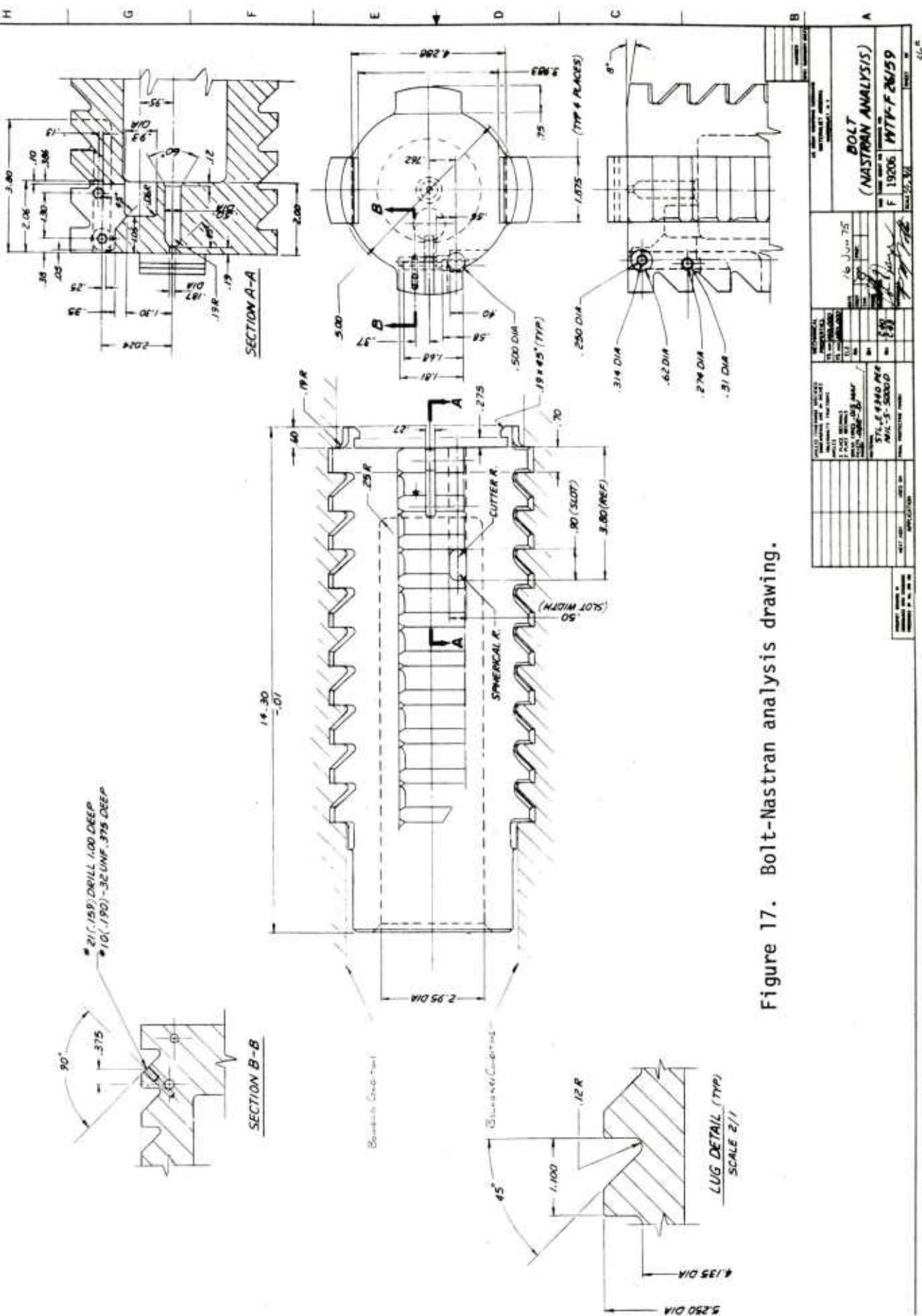


Figure 17. Bolt-Nastran analysis drawing.

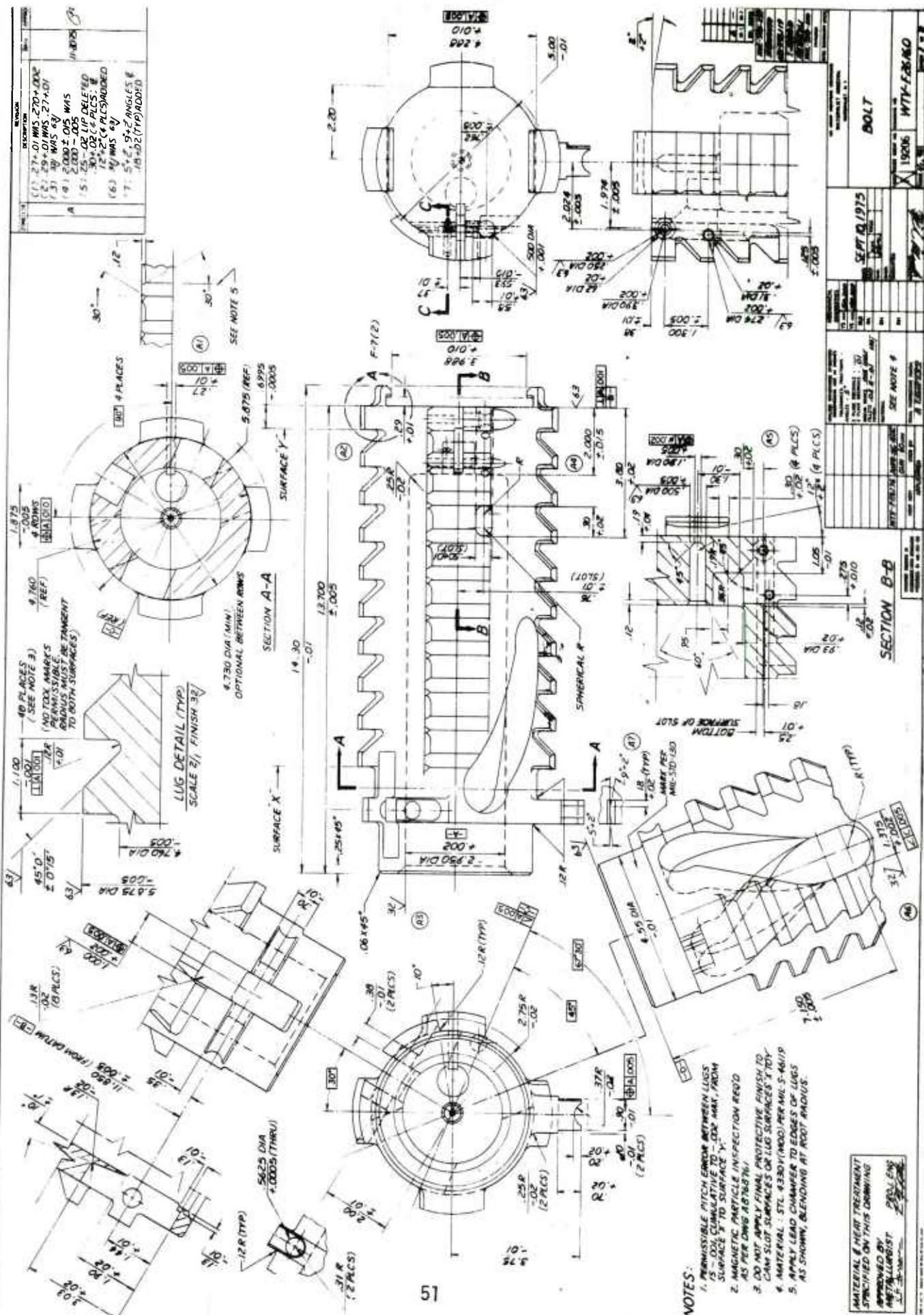


Figure 18. Bolt-finish machining drawing.

## WATERVLIET ARSENAL INTERNAL DISTRIBUTION LIST

May 1976

	<u>No. of Copies</u>
COMMANDER	1
DIRECTOR, BENET WEAPONS LABORATORY	1
DIRECTOR, DEVELOPMENT ENGINEERING DIRECTORATE	1
ATTN: RD-AT	1
RD-MR	1
RD-PE	1
RD-RM	1
RD-SE	1
RD-SP	1
DIRECTOR, ENGINEERING SUPPORT DIRECTORATE	1
DIRECTOR, RESEARCH DIRECTORATE	2
ATTN: RR-AM	1
RR-C	1
RR-ME	1
RR-PS	1
TECHNICAL LIBRARY	5
TECHNICAL PUBLICATIONS & EDITING BRANCH	2
DIRECTOR, OPERATIONS DIRECTORATE	1
DIRECTOR, PROCUREMENT DIRECTORATE	1
DIRECTOR, PRODUCT ASSURANCE DIRECTORATE	1
PATENT ADVISORS	1

## EXTERNAL DISTRIBUTION LIST

December 1976

1 copy to each

OFC OF THE DIR. OF DEFENSE R&E  
ATTN: ASST DIRECTOR MATERIALS  
THE PENTAGON  
WASHINGTON, D.C. 20315

CDR  
US ARMY TANK-AUTMV COMD  
ATTN: AMDTA-UL  
AMSTA-RKM MAT LAB  
WARREN, MICHIGAN 48090

CDR  
PICATINNY ARSENAL  
ATTN: SARPA-TS-S  
SARPA-VP3 (PLASTICS  
TECH EVAL CEN)  
DOVER, NJ 07801

CDR  
FRANKFORD ARSENAL  
ATTN: SARFA  
PHILADELPHIA, PA 19137

DIRECTOR  
US ARMY BALLISTIC RSCH LABS  
ATTN: AMXBR-LB  
ABERDEEN PROVING GROUND  
MARYLAND 21005

CDR  
US ARMY RSCH OFC (DURHAM)  
BOX CM, DUKE STATION  
ATTN: RDRD-IPL  
DURHAM, NC 27706

CDR  
WEST POINT MIL ACADEMY  
ATTN: CHMN, MECH ENGR DEPT  
WEST POINT, NY 10996

CDR  
HQ, US ARMY AVN SCH  
ATTN: OFC OF THE LIBRARIAN  
FT RUCKER, ALABAMA 36362

CDR  
US ARMY ARMT COMD  
ATTN: AMSAR-PPW-IR  
AMSAR-RD  
AMSAR-RDG  
ROCK ISLAND, IL 61201

CDR  
US ARMY ARMT COMD  
FLD SVC DIV  
ARMCOM ARMT SYS OFC  
ATTN: AMSAR-ASF  
ROCK ISLAND, IL 61201

CDR  
US ARMY ELCT COMD  
FT MONMOUTH, NJ 07703

CDR  
REDSTONE ARSENAL  
ATTN: AMSMI-RRS  
AMSMI-RSM  
ALABAMA 35809

CDR  
ROCK ISLAND ARSENAL  
ATTN: SARRI-RDD  
ROCK ISLAND, IL 61202

CDR  
US ARMY FGN SCIENCE & TECH CEN  
ATTN: AMXST-SD  
220 7TH STREET N.E.  
CHARLOTTESVILLE, VA 22901

DIRECTOR  
US ARMY PDN EQ. AGENCY  
ATTN: AMXPE-MT  
ROCK ISLAND, IL 61201

EXTERNAL DISTRIBUTION LIST (Cont)

1 copy to each

CDR  
US NAVAL WPNS LAB  
CHIEF, MAT SCIENCE DIV  
ATTN: MR. D. MALYEVAC  
DAHLGREN, VA 22448

DIRECTOR  
NAVAL RSCH LAB  
ATTN: DIR. MECH DIV  
WASHINGTON, D.C. 20375

DIRECTOR  
NAVAL RSCH LAB  
CODE 26-27 (DOCU LIB.)  
WASHINGTON, D.C. 20375

NASA SCIENTIFIC & TECH INFO FAC  
PO BOX 8757, ATTN: ACQ BR  
BALTIMORE/WASHINGTON INTL AIRPORT  
MARYLAND 21240

DEFENSE METALS INFO CEN  
BATTELLE INSTITUTE  
505 KING AVE  
COLUMBUS, OHIO 43201

MANUEL E. PRADO / G. STISSER  
LAWRENCE LIVERMORE LAB  
PO BOX 808  
LIVERMORE, CA 94550

DR. ROBERT QUATTRONE  
CHIEF, MAT BR  
US ARMY R&S GROUP, EUR  
BOX 65, FPO N.Y. 09510

2 copies to each

CDR  
US ARMY MOB EQUIP RSCH & DEV COMD  
ATTN: TECH DOCU CEN  
FT BELVOIR, VA 22060

CDR  
US ARMY MAT RSCH AGCY  
ATTN: AMXMR - TECH INFO CEN  
WATERTOWN, MASS 02172

CDR  
WRIGHT-PATTERSON AFB  
ATTN: AFML/MXA  
OHIO 45433

CDR  
REDSTONE ARSENAL  
ATTN: DOCU & TECH INFO BR  
ALABAMA 35809

12 copies

CDR  
DEFENSE DOCU CEN  
ATTN: DDC-TCA  
CAMERON STATION  
ALEXANDRIA, VA 22314

NOTE: PLEASE NOTIFY CDR, WATERVLIET ARSENAL, ATTN: SARWV-RT-TP,  
WATERVLIET, N.Y. 12189, IF ANY CHANGE IS REQUIRED TO THE ABOVE.

SUPPLEMENTAL DISTRIBUTION LIST

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander Picatinny Arsenal ATTN: ADED, Mr. E. Buchanan ADED, Mr. A. Strano Dover, NJ 07801	1	Commander US Army Missile Command ATTN: DRSMI-R Redstone Arsenal, AL 35809
2	Director Defense Advanced Research Projects Agency ATTN: Tech Info 1400 Wilson Blvd Arlington, VA 22209	1	Commander US Army Tank Automotive Logistics Command ATTN: DRCPM-MCV, BG S.Sheridan DRCPM-MCV-G, COL Spotts DRSTA-RHFL DRSTA-CV-D Warren, MI 48090
2	Office of Secretary of Defense ATTN: Mr. Yates Washington, DC 20301		Commander US Army Armament Command ATTN: DRSAR-RE DRSAR-REA DRSAR-RES DRSAR-RDF DRSAR-RDG DRSAR-RDT-L, Dr. T.Hung DRSAR-RDT-L, MAJ Houle DRSAR-LS, J. Rocha Rock Island, IL 61202
1	Commander US Army Materiel Development and Readiness Command ATTN: DRCMA DRCDMA-ST DRCDE-WD DRCDE-WI DRCDT DRCSF DRCQA-E DRCRD-W, G. Boward 5001 Eisenhower Ave Alexandria, VA 22333	1	Commander US Army Natick Research and Development Command ATTN: DRXRE, Dr. E. Sieling Natick, MA 01761
1	Commander US Army Aviation Systems Com ATTN: DRSAV-E 12th and Spruce Streets St. Louis, MO 63166	1	Commander US Army Infantry Center ATTN: ATZB-CDMSF, COL J. Hatch Fort Benning, GA 31905
1	Director US Army Air Mobility Research and Development Laboratory Ames Research Center Moffett Field, CA 94035	1	Director US Army Ballistics Research Lab ATTN: DRXBR-PR, Mr. A. Baran Aberdeen Proving Ground, MD 21005
1	Commander US Army Electronics Command ATTN: DRSEL-RD Fort Monmouth, NJ 07703		

**SUPPLEMENTAL DISTRIBUTION LIST**

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	Commander US Army Harry Diamond Labs ATTN: DRXDO-TI 2800 Powder Mill Road Adelphi, MD 20783	2	Commander US Naval Surface Wpns Center Silver Spring, MD 20910
1	Commander US Army TRADOC Systems Analysis Activity ATTN: ATAA-SA White Sands Missile Range NM 88002	3	Commander US Naval Surface Wpns Center ATTN: Code TEB, D.W. Colbertson Mr. L. Hock Code TX, Dr. W. Soper Dahlgren, VA 22448
1	Commander US Army Research Office ATTN: Dr. E. Saibel P. O. Box 12211 Research Triangle Pk, NC 27709	3	Commander US Naval Weapons Center ATTN: Code 4057, 753, 12 Code 5114, Dr. Lundstrom Code 6031, Mr. M. Backman China Lake, CA 93555
1	Deputy Assistant Secretary of the Army (R&D) Department of the Army Washington, DC 20310	1	Officer in Charge US Naval Weapons Center 3202 E. Foothill Boulevard Pasadena, CA 91107
1	Chief of Naval Research ATTN: Code ONR 439, N. Perrone Washington, DC 20360	1	Officer in Charge US Naval Weapons Center Corona Laboratories
1	Commander US Naval Air Systems Command ATTN: AIR-604 Washington, DC 20360	1	ATTN: Code 52, Dr. Brown S. G. Plentzas
1	Commander US Naval Ordnance Systems Com ATTN: ORD-9132 Washington, DC 20360	1	Corona, CA 91720
1	Commander US Naval Air Development Center, Johnsville Warminster, PA 18974	1	Director US Naval Research Laboratory
1	Commander and Director David W. Taylor Naval Ship Research & Development Center Bethesda, MD 20084	1	ATTN: Mr. W. J. Ferguson Mr. J. Baker Dr. H. Pusey Dr. F. Rosenthal
		1	Washington, DC 20375
1		1	AFOSR (W. J. Walker) Bolling AFB, DC 20332
1		1	ADTC/DLJW ATTN: CPT D. Matuska Eglin AFB, FL 32542

SUPPLEMENTAL DISTRIBUTION LIST

<u>No. of Copies</u>	<u>Organization</u>	<u>No. of Copies</u>	<u>Organization</u>
1	AFATL (DLDL, MAJ J. Morgan) Eglin AFB, FL 32542	1	HQ, DA ATTN: DRMA-ARZ-D
1	AFWL (WLL) Kirtland AFB, NM 87117	1	DRMA-WSW, COL Manhan DRMA-CSM, LTC N. Conner Washington, DC 20310
1	AFFDL (FDT) Wright-Patterson AFB, OH 45433	1	Director US Army Ballistics Research Lab ATTN: DRXBR-IBL, Dr. B. Burns DRXBR-IBL, Mr. G. Samos Aberdeen Proving Ground, MD 21005
3	ASD (YH/EX; John Rievley; XRHD, Gerald Bennett ENYS, Matt Kolleck) Wright-Patterson AFB, OH 45433	1	Commander Frankford Arsenal ATTN: SARFA-MDA-A, Mr. D. Donolly SARFA-MDA-A, Mr. Robertson SARFA-FCS-N. Mr. I. Goldberg Philadelphia, PA 19137
2	Commander US Marine Corps ATTN: A04F; AX Washington, DC 20380	1	Commander Rock Island Arsenal ATTN: SARRI-LA-AC, Mr. W. Wells Rock Island, IL 61201
1	Marine Corps Liaison Officer US Army Aviation Test Board Fort Rucker, AL 36362	1	Commander Picatinny Arsenal ATTN: SARPA-AD-D-A-2 Mr. V. Guadagno Dover, NJ 07801
1	HQ USAF (DPPTB, LTC Smith) Washington, DC 20330	1	Proj Mgr, XM1 Tank System 28150 Dequindre
Aberdeen Proving Ground			
1	Marine Corps Ln Ofc Cdr, USATECOM	1	ATTN: DRCPM-GCM-M, LTC Appling
1	ATTN: DRSTE-BE Dir, MTD	1	Warren, Mich 48092
1	ATTN: STEAP-MT STEAP-MT-TI	1	Department of the Army Office of the Deputy Chief of
1	Dir, USAMSA ATTN: Dr. J. Sperrazza	1	Staff for Res, Dev & Acquisition
1	Mr. R. Simmons	1	ATTN: DRMA-WSW (LTC P. Wickliffe)
1	Mr. W. Brooks	1	Washington, DC 20310
1	Mr. H. Kostiak		
1	Mr. D. O'Neill		
1	Dir, USAHEL ATTN: Mr. J. Torre		
1	Mr. R. Kramer		
	Aberdeen Proving Ground, MD 21005		